THE FOUNDRY

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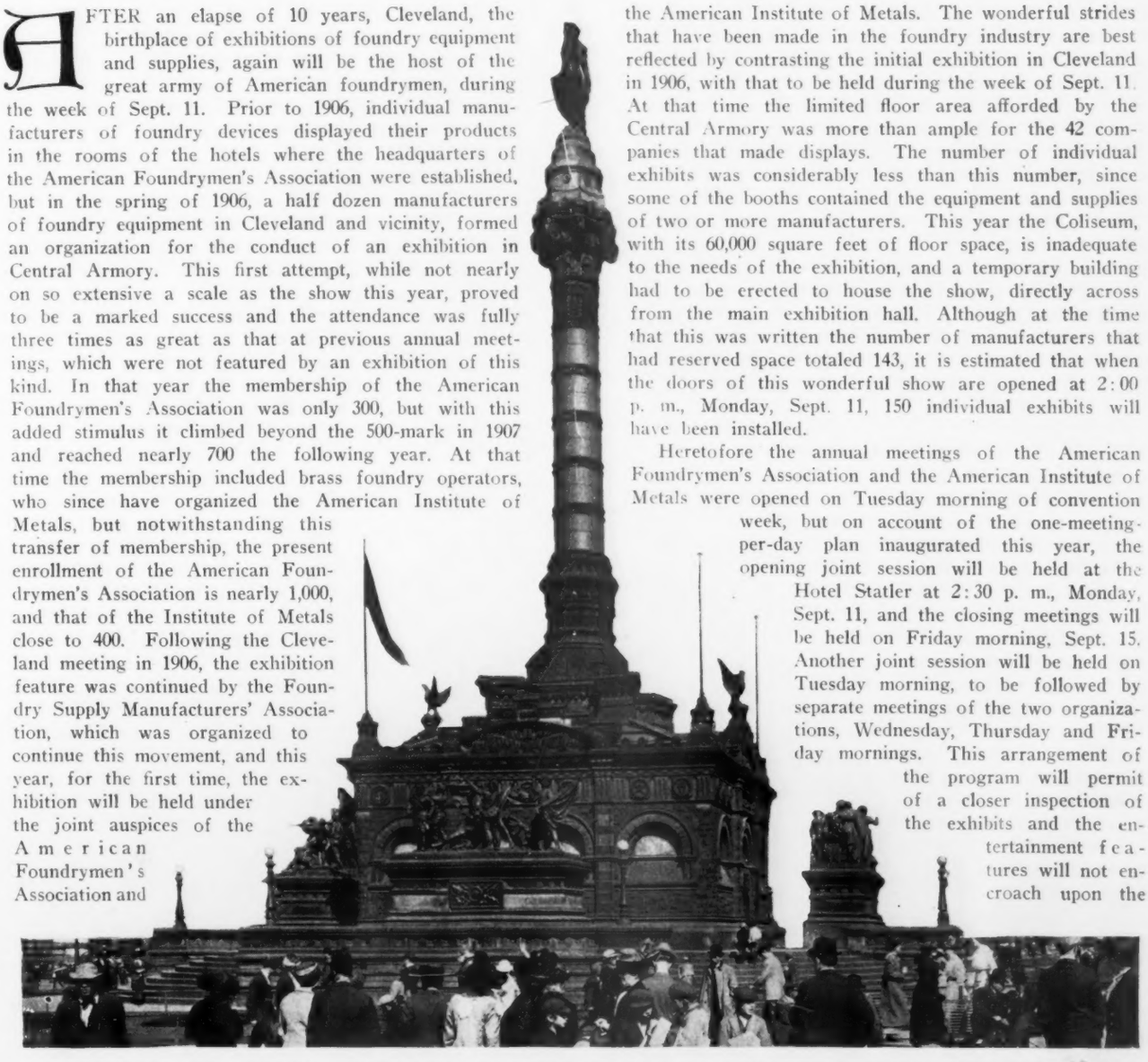
Stage is All Set for Great Cleveland Convention

Full Details of the Programs of the American Foundrymen's Association and American Institute of Metals—Exhibition Will Eclipse All Previous Shows

AFTER an elapse of 10 years, Cleveland, the birthplace of exhibitions of foundry equipment and supplies, again will be the host of the great army of American foundrymen, during the week of Sept. 11. Prior to 1906, individual manufacturers of foundry devices displayed their products in the rooms of the hotels where the headquarters of the American Foundrymen's Association were established, but in the spring of 1906, a half dozen manufacturers of foundry equipment in Cleveland and vicinity, formed an organization for the conduct of an exhibition in Central Armory. This first attempt, while not nearly on so extensive a scale as the show this year, proved to be a marked success and the attendance was fully three times as great as that at previous annual meetings, which were not featured by an exhibition of this kind. In that year the membership of the American Foundrymen's Association was only 300, but with this added stimulus it climbed beyond the 500-mark in 1907 and reached nearly 700 the following year. At that time the membership included brass foundry operators, who since have organized the American Institute of Metals, but notwithstanding this transfer of membership, the present enrollment of the American Foundrymen's Association is nearly 1,000, and that of the Institute of Metals close to 400. Following the Cleveland meeting in 1906, the exhibition feature was continued by the Foundry Supply Manufacturers' Association, which was organized to continue this movement, and this year, for the first time, the exhibition will be held under the joint auspices of the American Foundrymen's Association and the American Institute of Metals. The wonderful strides that have been made in the foundry industry are best reflected by contrasting the initial exhibition in Cleveland in 1906, with that to be held during the week of Sept. 11. At that time the limited floor area afforded by the Central Armory was more than ample for the 42 companies that made displays. The number of individual exhibits was considerably less than this number, since some of the booths contained the equipment and supplies of two or more manufacturers. This year the Coliseum, with its 60,000 square feet of floor space, is inadequate to the needs of the exhibition, and a temporary building had to be erected to house the show, directly across from the main exhibition hall. Although at the time that this was written the number of manufacturers that had reserved space totaled 143, it is estimated that when the doors of this wonderful show are opened at 2:00 p. m., Monday, Sept. 11, 150 individual exhibits will have been installed.

Heretofore the annual meetings of the American Foundrymen's Association and the American Institute of Metals were opened on Tuesday morning of convention week, but on account of the one-meeting-per-day plan inaugurated this year, the opening joint session will be held at the Hotel Statler at 2:30 p. m., Monday, Sept. 11, and the closing meetings will be held on Friday morning, Sept. 15. Another joint session will be held on Tuesday morning, to be followed by separate meetings of the two organizations, Wednesday, Thursday and Friday mornings. This arrangement of the program will permit of a closer inspection of the exhibits and the entertainment features will not encroach upon the



A LANDMARK FOR VISITING FOUNDRYMEN—SOLDIERS' AND SAILORS' MONUMENT, PUBLIC SQUARE, CLEVELAND

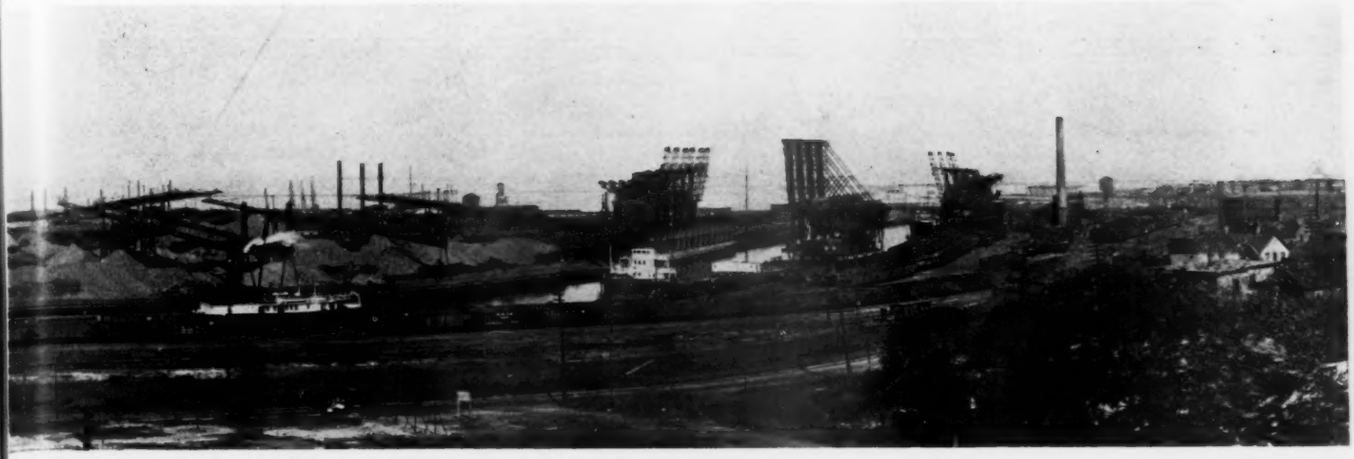
A VIEW OF CLEVELAND'S GREAT UNLOADING DOCKS ON LAKE ERIE

technical sessions as in the past. The headquarters for the American Foundrymen's Association and the American Institute of Metals will be at the Hotel Statler, while that of the exhibitors will be at the Hotel Hollenden. The Coliseum and Annex, where the exhibition will be held, are in close proximity to the hotel headquarters, the Hollenden being three blocks distant and the Statler, one block.

The technical program of the American Foundrymen's Association is the most elaborate and complete in the history of that organization. It contains 40 papers and addresses and 11 committee reports. To provide ample opportunity for discussions, simultaneous sessions will be held Thursday and Friday mornings. General topics will be considered on Wednesday, followed by steel and malleable sessions on Thursday and gray iron and steel on Friday. The final business meeting will be called to order at noon on Friday, the gray iron and steel sessions to be adjourned at this hour to enable the members to attend the meeting to close the convention. At the joint opening session, Monday afternoon, the reports of the officers will be submitted and the negotiations leading to the management of the exhibition by the two allied associations and the incorporation of the American Foundrymen's Association, will be outlined in detail. Local and national official recognition has been accorded the foundrymen's convention this year. The address of welcome will be delivered by Hon. H. L. Davis, mayor of the City of Cleveland, and Hon. Newton D. Baker, secretary of war, will deliver the banquet address.

The program of the American Foundrymen's Association contains three interesting symposiums, by four authors each, respectively on the gating of castings, the relation of the engineer to the foundry and the manufacture of electric steel castings. A new safety code for iron, steel and brass foundries, which is claimed to be a big improvement on the rules now in force in several states, will be presented for adoption and the action that will be taken will be of far-reaching importance throughout the United States. The report of the Committee on Foundry Scrap represents the first effort on the part of any organization to bring order out of the chaos which exists in the purchase of this material and the making of quotations on a uniform net ton basis in every important scrap center will be recommended. The old material for every foundry use also has been classified and if this report is adopted the first step will be taken toward the elimination of the hit-or-miss method of scrap purchase. The reclamation of waste foundry sand is another topic that will be considered by several authors and the methods to be

SIXTH IN POPULATION, FIFTH IN MANUFACTURES, CLEVELAND THE



WHERE NINE MILLION TONS OF IRON ORE ARE HANDLED YEARLY

described will effect economies in every foundry where they are adopted.

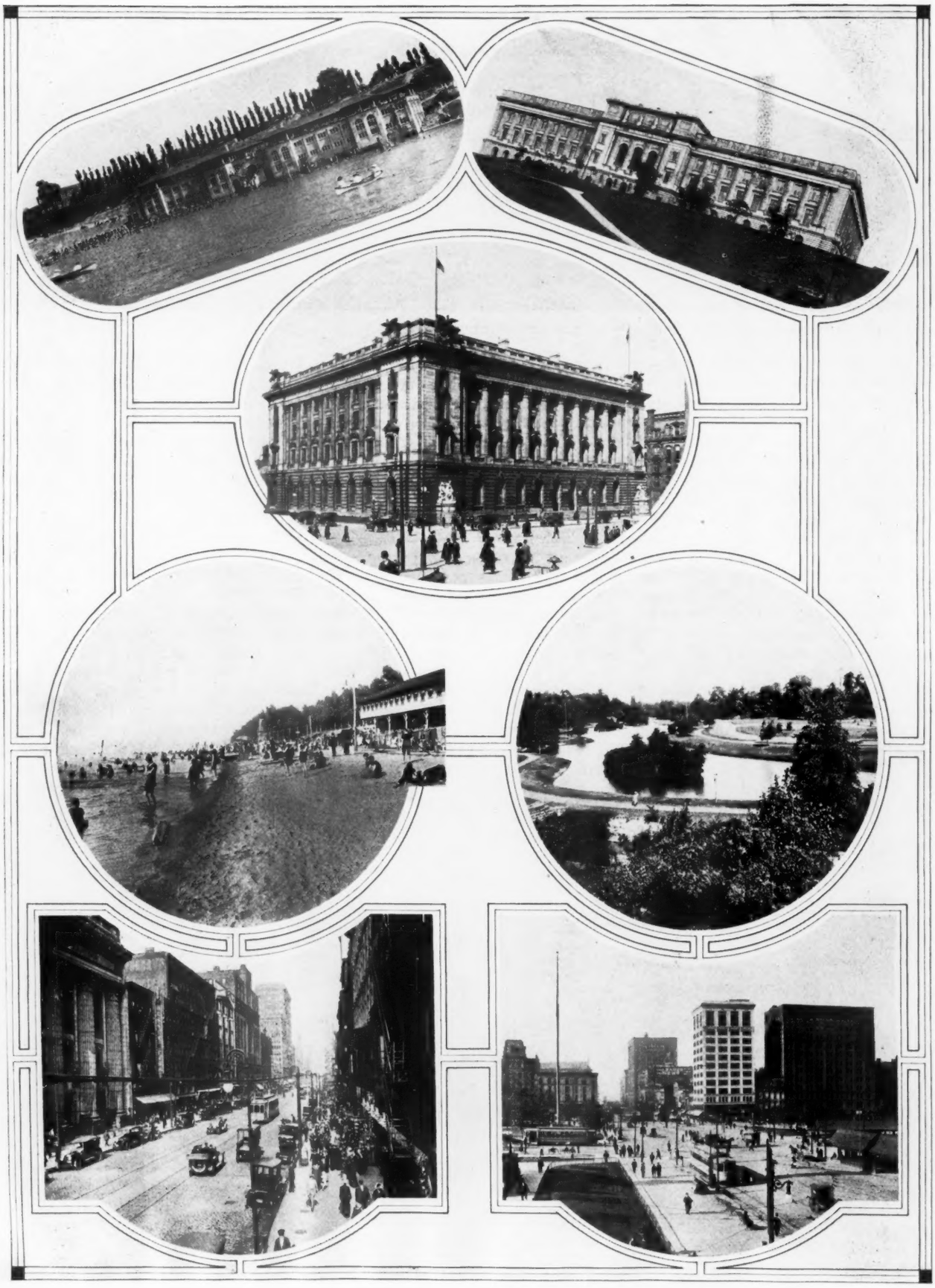
Joint meetings of the American Institute of Metals will be held with the American Foundrymen's Association, at the Hotel Statler, Monday afternoon and Tuesday morning and separate sessions will be held on Wednesday, Thursday and Friday mornings. The program is unusually complete, containing 21 papers on all phases of brass foundry and rolling mill work. Brass foundry practice will be discussed Wednesday morning; heat-treatment, corrosion, etc., Thursday and papers on physical tests, metallography, etc., will be read Friday morning.

The exhibition of foundry supplies and equipment, machine tools and accessories, to be held in the Coliseum and Annex, will be opened formally at 2:30 p. m., Monday, Sept. 11, and will close at 5:00 p. m., Saturday, Sept. 16. The two buildings, afford approximately 70,000 square feet of floor space, a large part of which will be occupied by operating exhibits. Demonstrations of molding machines and other heavy machinery and equipment will be made in the Annex, although smaller operating exhibits also will be located in the Coliseum. Saturday, Sept. 16, will be Cleveland Day at the exhibition and it is probable that many local shops will shut down to enable their employes to attend the exhibition.

An unusually elaborate entertainment program has been provided by the foundrymen of Cleveland, which includes a ball game Tuesday afternoon, Sept. 12, contest between the Cleveland and Detroit teams of the American league; a theater party Tuesday evening; an inspection trip to the Cleveland Blast Furnace Co.'s plant Wednesday afternoon, Sept. 13; a trip to Euclid Beach park Wednesday evening in special cars which will be parked on Walnut street between Ninth and Twelfth streets, two blocks north of the Hotel Statler, and which will leave for the park at 7:30 p. m. The visiting ladies will receive tickets for the ball game, theater party and Euclid Beach park and in addition they will be given a luncheon at the Hotel Statler at noon, Wednesday, Sept. 13, and at 2:00 o'clock the same day they will leave on a sightseeing automobile trip, which will include the entire park system of the Forest City.

Hon. Newton D. Baker, secretary of war, will be the principal speaker at the annual banquet to be held at the Hotel Statler, Thursday evening, Sept. 14. Mr. Baker is a speaker of unusual ability and his address this evening will attract international attention. The only other speaker of the evening will be the noted humorist, Irving Bacheller, whose topic will be "The Cheerful Yankee". Plant visitation will be limited

INDUSTRIAL GIANT WELCOMES THE VISITING FOUNDRYMAN



CHARACTERISTIC SCENES IN CLEVELAND, THE CONVENTION CITY

to Thursday and Friday, Sept. 14 and 15.

The local general committee in charge of the reception and entertainment of the visiting foundrymen is headed by F. B. Whitlock, of the Interstate Foundry Co., chairman. The chairmen of the other committees follow: H. J. Boggis, Taylor & Boggis Foundry Co., chairman of the reception committee; Philip Frankel, secretary of the Cleveland Foundrymen's Association, is vice chairman of the reception committee; Sterling W. Hubbard, Rogers, Brown & Co., is chairman of the entertainment committee; J. S. Smith, Smith Facing & Supply Co., chairman of the plant visitation committee; W. B. Greene, Palmer & De Mooy Foundry Co., chairman of the golf committee, and Mrs. W. C. Sly, 13474 Lake avenue, is chairman of the ladies' reception committee. The finance committee consists of J. C. Brainerd, chairman, Johnston & Jennings Co., and the other members of this committee include W. B. Greene and Philip Frankel.

Plant visitation will be limited to two days, Thursday and Friday, Sept. 14 and 15. This arrangement will enable the local committee to concentrate its efforts since there will be no interference with the entertainment program. The inspection of plants by groups of visitors has been provided for at designated hours, which will insure better attention than if plant visitation were continued throughout the week. The most modern shops in the city have been selected by the committee, which insures the success of this feature, although special arrangements can be made for visits to other plants than those specially selected.

A list of the plants to be visited, together with the hours set apart for inspection, follows:

Ferro Machine & Foundry Co., Thursday, Sept. 14, 9:00 a. m. to 12:00 m. This plant specializes in the manufacture of automobile, motor boat and other gas engine cylinders.

Interstate Foundry Co., Friday, Sept. 15, 9:00 a. m. to 12:00 m. This plant specializes in automobile work.

Westinghouse Electric & Mfg. Co., all day Thursday and Friday, Sept. 14 and 15. In this plant recently has been installed a continuous system of operation, which includes sand-conveying apparatus linked up to the molding machines, with pouring by a separate gang throughout the day. The new cleaning room also is a model of its kind.

West Steel Casting Co., all day Friday, Sept 15. This foundry specializes in the manufacture of light steel castings, particularly wheels for motor trucks.

Allyne-Ryan Foundry Co., Thursday and Friday, Sept. 14 and 15, 9:00 a. m. to 12:00 m. This is one of the largest automobile cylinder foundries in the United States and the methods pursued in this shop will prove to be a revelation to the visiting foundrymen.

Condensed Program

Monday, Sept. 11.

9:00 A. M.—Registration, mezzanine floor, Hotel Statler.

2:00 P. M.—Opening of the Exhibition in the Coliseum and the Annex.

2:30 P. M.—Joint opening session, American Foundrymen's Association and American Institute of Metals, Hotel Statler.

Tuesday, Sept. 12.

10:00 A. M.—Joint session, American Foundrymen's Association and American Institute of Metals, Hotel Statler.

3:00 P. M.—Ball game, Cleveland vs. Detroit, American League Park.

8:15 P. M.—Theater party.

Wednesday, Sept. 13.

10:00 A. M.—Professional session of the American Foundrymen's Association for the discussion of general topics, at the Hotel Statler.

10:00 A. M.—Professional session of the American Institute of Metals at the Hotel Statler, for the discussion of foundry practice.

12:00 M.—Ladies' luncheon at the Hotel Statler.

1:00 P. M.—Inspection of the Cleveland Furnace Co.'s plant. Sight-seeing automobiles will make trips at 30-minute intervals from Hotel Statler to the blast furnace plant.

2:00 P. M.—Ladies' sight-seeing automobile trip.

7:30 P. M.—Trip to Euclid Beach Park in special cars.

Thursday, Sept. 14.

10:00 A. M.—Steel session, American Foundrymen's Association, Hotel Statler.

10:00 A. M.—Malleable session, American Foundrymen's Association, Hotel Statler.

10:00 A. M.—Professional session of the American Institute of Metals at the Hotel Statler, for the discussion of heat-treatment, corrosion, etc.

7:00 P. M.—Annual banquet, Hotel Statler.

Friday, Sept. 15.

10:00 A. M.—Gray iron session, American Foundrymen's Association, Hotel Statler.

10:00 A. M.—Steel session, American Foundrymen's Association, Hotel Statler.

10:00 A. M.—Professional session of the American Institute of Metals at the Hotel Statler, for the discussion of physical tests, metallography, etc.

12:00 M.—Final business session of the American Foundrymen's Association at the Hotel Statler.

Saturday, Sept. 16.

5:00 P. M.—Exhibition closes.

Plant visitation is limited to Thursday and Friday, Sept. 14 and 15.

City Foundry Co., all day Thursday and Friday, Sept. 14 and 15. This is a large gray iron foundry specializing in machinery work.

Best Foundry Co., Bedford, O., all day Thursday and Friday, Sept. 14 to 15. This is one of the largest stove foundries in the United States, all of the work being made on molding machines.

The members of the plant visitation committee follow: J. S. Smith, Smith Facing & Supply Co., chairman; Frank W. Dodge, S. Obermayer Co.; G. H. Bowers, Interstate Foundry Co.; D. J. Ryan, Allyne-Ryan Foundry Co.; W. G. Smith, Werner G. Smith Co.; C. E. Knowlton, Westinghouse Electric & Mfg. Co., and J. I. Barry, Ferro Machine & Foundry Co.

The history of the foundry industry in Cleveland may be traced back nearly to the time when the city itself was founded by the scant handful of pioneers who endured untold hardships during their journey from the east before they reached the place of their choice where the crooked Cuyahoga empties its muddy waters into Lake Erie. Almost before their crude log cabins were completed, the settlers turned their efforts to ship building, to which industry Cleveland foundries owe their origin. During the first few years of its existence, Cleveland enjoyed a normal growth, but could boast of nothing unusual either commercially or industrially. The advent of the railroads and the extension of the paths of commerce on the Great Lakes created possibilities for Cleveland that were far beyond the imagination of early settlers, who waited patiently while all of their raw and finished products were hauled in crude wagons or towed in canal boats from the commercial centers of the Atlantic seaboard and the manufacturing districts east of the Alleghenies.

But when, in the middle of the last century, the railroads were established between Cleveland and the coal fields and the boats began to enter the port loaded with iron ore and other products from the wonderful deposits of the Superior region, Cleveland's development started and has continued without pause. Within a few years after the first locomotive reached the city, Cleveland was recognized as one of the leading railroad and shipping centers of the middle west. Blast furnaces were built to smelt the iron ore and industry after industry was started to convert the raw materials into refined products. Thus, in a period of slightly more than 100 years, Cleveland has developed into a city of over 700,000 people, taking high rank among American cities for the diversity of its industries and the quality of its manufactured products.

Cleveland, sixth in the United States in population, ranks third in the number of foundries within the city limits. The following authoritative figures give the number of foundries in the first four cities of United States but do not include general offices of foundries not

located within the city limits: Chicago, 170; New York, 115; Cleveland, 112, and Philadelphia, 106. That Cleveland has maintained its rank among the leading foundry centers is indicated by similar figures showing the rank of the same cities in 1906. In that year Chicago had 144 foundries, Philadelphia 100, New York 90, and Cleveland 81. During the past 10 years, however, the foundry industry in Cleveland has shown the greatest percentage increase, having expanded 38 per cent in comparison with 28 per cent for New York, 18 per cent for Chicago, and 6 per cent for Philadelphia. If this rate of growth were continued for a few years, Cleveland would soon assume second place and a period of slightly more than a decade would place Cleveland in the lead.

A normal and healthy expansion of an industry is gratifying, but cannot always be relied upon as a criterion of progress, if numbers alone are considered. Cleveland foundrymen are reputed to be quick to adopt improvements and innovations in shop methods and the city enjoys the reputation of having some of the best equipped foundries in the country. It also is a center for the manufacture of molding machines and other foundry equipment. Co-operation between the foundrymen and the several builders of foundry equipment located in Cleveland is responsible, to some extent, for the development which has so materially advanced foundry practice through the country within comparatively recent years. Although labor is unusually expensive at the present time, the modern equipment to be found in Cleveland foundries has enabled Cleveland concerns to maintain low production costs and to establish themselves in commanding positions, even in competitive territory.

The production of light gray iron castings is by far the most important component of Cleveland's foundry industry. In this Cleveland is said to lead the world. The greatest part of the iron melted for light gray iron castings is used in automobile cylinders. Cleveland foundries cast approximately 500,000 complete sets of automobile cylinders every year. The three leading manufacturers of these castings melt, on an average, 300 to 350 tons of iron a day, producing nearly 4,500 sets of cylinders. The automobile industry not only calls upon Cleveland for cylinder castings, but also for a large portion of the various brass and aluminum castings which are so essential in the modern motor car. One of the largest aluminum foundries in United States is located in Cleveland, and although this metal has been generally used but 14 years, the production of aluminum castings is one of the most important phases of Cleveland's foundry industry. During recent years an enormous demand

Program, American Foundrymen's Association

Monday, Sept. 11, 9:00 a. m.

Registration, mezzanine floor, Hotel Statler.

Monday, Sept. 11, 2:30 p. m., Hotel Statler.

Joint opening session, American Foundrymen's Association and American Institute of Metals.

Address of welcome, by Hon. Harry L. Davis, mayor of the City of Cleveland.

Response to address of welcome, by Alfred E. Howell, Phillips & Buttorff Mfg. Co., Nashville, Tenn.

Annual address, including summary of activities of the Executive Board, Incorporators and Committees on exhibit affairs, by R. A. Bull, president American Foundrymen's Association.

Annual address, by Jesse L. Jones, president, American Institute of Metals.

Annual report of the secretary-treasurer of the American Foundrymen's Association, by A. O. Backert, Cleveland.

Appointment of nominating committee and committee on resolutions.

Tuesday, Sept. 12, 10:00 a. m., Hotel Statler.

Joint session, American Foundrymen's Association and American Institute of Metals.

Symposium on "The Results of Closer Co-Operation Between the Engineer and the Foundry," as relating to:

"Gray Iron," by D. W. Sowers, Sowers Mfg. Co., Buffalo.

"Steel," by John Howe Hall, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

"Malleable Iron," by G. F. Meehan, Ross-Meehan Foundries, Chattanooga, Tenn.

"Non-Ferrous Metals," by C. E. Chase, Modjeski & Angier, Chicago.

Symposium on "The Influence of Gating on Castings," covering:

"Gray Iron," by B. D. Fuller, Westinghouse Electric & Mfg. Co., Cleveland.

"Steel," by William Gilmore, Hubbard Steel Foundry Co., East Chicago, Ind.

"Malleable Iron," by A. M. Fulton, Fort Pitt Malleable Iron Co., Pittsburgh.

"Non-Ferrous Metals," by R. R. Clarke, Penna. Lines West, North Side, Pittsburgh.

"Waste Foundry Sand," by H. B. Swan, Cadillac Motor Car Co., Detroit, and H. M. Lane, consulting engineer, Detroit.

"The Significance of the Fire Waste," by Franklin H. Wentworth, secretary, National Fire Protection Association, Boston.

"What the Pratt Institute Has Done, Is Doing and Hopes to Do, in the Training of Men for the Foundry Industry," by Samuel S. Edmands, Pratt Institute, Brooklyn.

"Analyzing Foundry Operations as a Basis for Improvement in Shop Conditions," by R. E. Kennedy, University of Illinois, Urbana, Ill.

"Foundry Work at the University of Nebraska," by John Grenman, University of Nebraska, Lincoln, Neb.

Tuesday, Sept. 12, 3:00 p. m.

Ball game, Cleveland vs. Detroit, League Park.

Tuesday, Sept. 12, 8:15 p. m.

Theater party, Keith's Hippodrome.

Wednesday, Sept. 13, 10:00 a. m., Hotel Statler.

GENERAL TOPICS

Report of A. F. A. Committee on Foundry Costs, by B. D. Fuller, chairman, Westinghouse Electric & Mfg. Co., Cleveland.

"Foundry Costs," by Clinton H. Scovell, Clinton H. Scovell & Co., Boston.

"Profit-Sharing as a Factor in Preparedness," by C. E. Knoeppel, C. E. Knoeppel Co., New York.

Report of A. F. A. Committee on Foundry Scrap, by G. E. Jones, chairman, Whiting Foundry Equipment Co., Harvey, Ill.

Report of the A. F. A. Representatives on the Conference Board on Training of Apprentices, by B. D. Fuller, chairman, Westinghouse Electric & Mfg. Co., Cleveland.

Report of A. F. A. Advisory Committee to the United States Bureau of Standards, by Richard Moldenke, chairman, Watchung, N. J.

"How Some Cleaning Room Problems Have Been Solved," by H. Cole Estep, THE FOUNDRY, Cleveland.

"The Introduction of the Molding Machine in Foundries," by A. O. Backert, Penton Publishing Co., Cleveland.

Report of nominating committee and election of directors of the American Foundrymen's Association, Incorporated.

Wednesday, Sept. 13, 12:00 m.

Ladies' luncheon at the Hotel Statler.

Wednesday, Sept. 13, 1:00 p. m.

Inspection of the Cleveland Furnace Co. plant. Sightseeing automobiles will make trips at 30-minute intervals from the Hotel Statler to the blast furnace plant.

for aluminum castings for vacuum cleaners has developed, while the advent of aluminum pistons promises to make still further demands upon Cleveland's aluminum foundries. Also, this city is noted throughout the United States as a manufacturing center of brass and bronze plumbing fixtures.

Although Cleveland may not be classed as a foundry center of the first importance in the production of large iron and steel castings, there are several foundries in the city which produce exceptionally heavy castings in large quantities. One of these is operated by a leading ship building company and is capable of turning out castings weighing up to 20 tons. The greatest proportion of the work at this foundry is confined to the production of castings used on vessels such as bed plates, propellers, hubs and other parts made of semi-steel and iron. Several firms in Cleveland specialize in making large steel castings for rolling mills and similar purposes. One foundry has a wide reputation for the production of castings used in sugar mill machinery.

Excellent transportation facilities have been responsible, in a measure, for the industrial development of Cleveland. This city is served by 10 steam railroads, a number of interurban lines and by 45 steamship companies conducting a strictly freight business. These facilities not only aid the foundry industry by providing a cheap and rapid means of shipping the raw and finished products, but serve to increase the volume of foundry business in Cleveland because numerous castings are demanded for the construction and maintenance of railroad and vessel equipment. Therefore, in addition to the ship building shops, several railroad foundries are located in Cleveland. Two foundries directly interested in this phase of the work produce thousands of cast iron car wheels annually.

Devotees of the game of golf will be afforded the privilege of the club houses and links of five clubs, throughout convention week. All of the expenses will be defrayed by Cleveland foundrymen and the members of the golf committee will be the sponsors of the visitors. Guest cards to any of the clubs may be obtained at the registration desk on the mezzanine floor of the Hotel Statler. The members of the golf committee with the names of the clubs with which they are affiliated, follow: W. B. Greene, Palmer & De Mooy Foundry Co., chairman; J. C. Brainerd, Johnston & Jennings Co., Shaker Heights Country Club; H. W. Haggerty, Corrigan, McKinney & Co., Shaker Heights Country Club; B. D. Fuller, Westinghouse Electric & Mfg. Co., Westwood Country Club; A. J. Kronke, Cleveland Chaplet & Mfg. Co., Keswick Golf Club; H. L. Leonard, Ferro Machine & Foun-

Program, American Foundrymen's Association

(*Continued from page 340*)

Wednesday, Sept. 13, 2:00 p. m.

Ladies' sight-seeing automobile trip.

Wednesday, Sept. 13, 7:30 p. m.

Trip to Euclid Beach Park in special cars.

Thursday, Sept. 14, 10:00 a. m., Hotel Statler.

STEEL SESSION

Symposium on "Electric Furnace Practice":

"The Ideal Electric Furnace for the Steel Foundry," by F. J. Ryan, E. B. McKee and W. D. Walker, Snyder Electric Furnace Co., Chicago.

"The Electric Furnace in the Foundry," by E. B. Clarke, Buchanan Electric Steel Co., Buchanan, Mich.

"Gronwall-Dixon Electric Melting and Refining Furnace," by John A. Crowley, John A. Crowley Co., New York.

"Electric Furnace Practice in the Manufacture of Steel Castings," by T. S. Quinn, Lebanon Steel Foundry Co., Lebanon, Pa.

"Electric and Converter Steel Compared," by Peter Blackwood, Blackwood Steel Foundry Co., Springfield, O.

"The Manufacture of Manganese Steel Castings," by W. S. McKee, American Manganese Steel Co., Chicago.

"The Presence of Alumina in Steel," by G. F. Comstock, Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

Thursday, Sept. 14, 10:00 a. m., Hotel Statler.

MALLEABLE SESSION

"The 25-Ton Air Furnace," by F. C. Rutz, Rockford Malleable Iron Works, Rockford, Ill.

"What is the Normal Fracture of Good Malleable Iron?" by Enrique Touceda, Albany, N. Y.

"The Commercial Side of the Malleable Iron Industry," by W. G. Kranz, National Malleable Casting Co., Cleveland.

"The Application of Malleable Iron Castings in Car Construction," by Frank J. Lanahan, Fort Pitt Malleable Iron Co., Pittsburgh.

Report of A. F. A. Committee on Standard Specifications for Malleable Iron Castings, by Enrique Touceda, chairman, Albany, N. Y.

"Suggested Standards for Pattern Parts," by W. W. Carlson, Kansas State Agricultural College, Manhattan, Kas.

Thursday, Sept. 14, 7:00 p. m.

Annual banquet, Hotel Statler.

Friday, Sept. 15, 10:00 a. m., Hotel Statler

GRAY IRON SESSION

"The Effects of Different Mixtures on the Strength of Chilled Car Wheels," by G. S. Evans, Lenoir Car Works, Lenoir City, Tenn.

"Semi-Steel," by David McLain, McLain's System, Milwaukee.

Report of A. F. A. Committee on Standard Methods for Analyzing Coke, by H. E. Diller, chairman, General Electric Co., Erie, Pa.

"Use of By-Product Coke in Foundries," by George A. T. Long, Pickands, Brown & Co., Chicago.

"The Use of Borings in Cupola Operation," by James A. Murphy, Hooven, Owens & Rentschler Co., Hamilton, O.

"The Use of Cheaper Materials," by C. C. Kawin, Charles C. Kawin Co., Chicago.

"One-Third of a Century in a Gray Iron Foundry," by Alfred E. Howell, Phillips & Buttorff Mfg. Co., Nashville, Tenn.

"Thermal Reactions in Gray Iron," by Thomas Turner, The University, Birmingham, Eng.

Report of A. F. A. Committee on General Specifications for Gray Iron Castings, by W. P. Putnam, chairman, Detroit Testing Laboratory, Detroit.

Friday, Sept. 15, 10:00 a. m., Hotel Statler

STEEL SESSION

"The Use of Titanium in the Manufacture of Steel Castings," by W. A. Janssen, Bettendorf Co., Davenport, Ia.

"Acid versus Basic Steel for Making Castings," by E. F. Cone, *The Iron Age*, New York.

"Alloy Steel Castings," by David Evans, Chicago Steel Foundry Co., Chicago.

"Theory and Practice in Gating and Heading Steel Castings," by Ralph D. West, West Steel Casting Co., Cleveland.

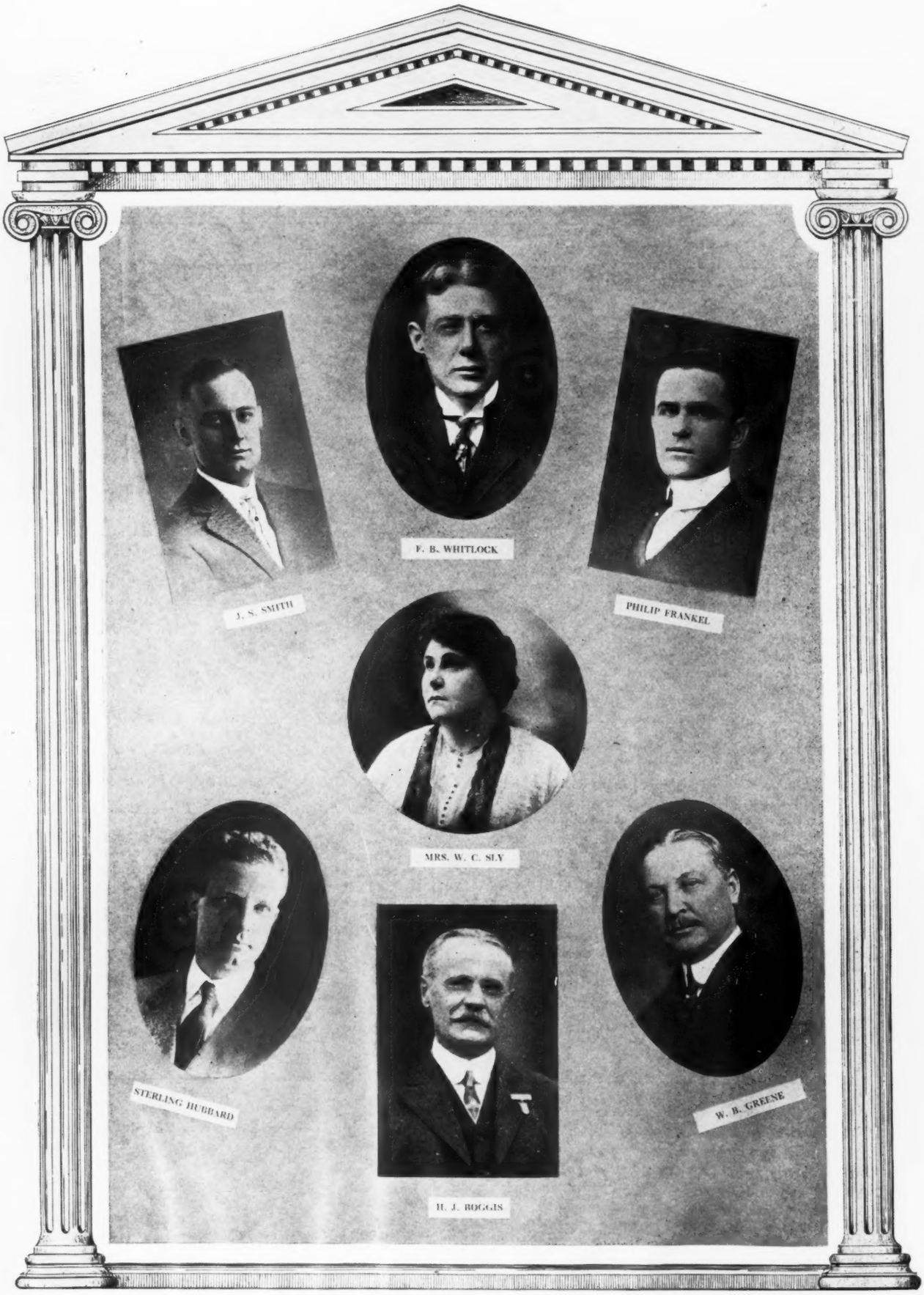
"The Small Open-Hearth as a Flexible Unit for Either Large Steel Foundries or General Jobbing Shops," by Frank Carter, Milwaukee.

Report of A. F. A. Committee on Specifications for Steel Castings, by John Howe Hall, chairman, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

Friday, Sept. 15, 12:00 m., Hotel Statler

Report of the election of officers by the board of directors of the American Foundrymen's Association, incorporated.

Report of special committees. Appointment of standing committees. Unfinished business. New business. Installation of new officers. Approval of proceedings.



CHAIRMEN OF CLEVELAND LOCAL COMMITTEES

dry Co., Willowick Country Club, and M. C. Rosenfeld, Grabler Mfg. Co., Oakwood Club.

The reception, entertainment and ladies' committees are constituted as follows:

Reception Committee.—Herbert J. Boggis, Taylor & Boggis Foundry Co., chairman; Philip Frankel, Cleveland Foundrymen's Association, vice chairman; J. J. Bever, Otis Steel Co.; C. S. Carman, Osborn Mfg. Co.; J. J. Carroll, National Malleable Castings Co.; H. Cole Estep, Penton Publishing Co.; W. D. Fraser, Berkshire Mfg. Co.; P. O. Geoghegan, Ohio Foundry Co.; H. W. Haggerty, Corrigan, McKinney & Co.; Wm. McLauchlan, Pickands, Mather & Co.; W. W. Merriman, Madison Foundry Co.; H. M. Molder, Best Foundry Co., Bedford, O.; Crispin Oglebay, Ferro Machine & Foundry Co.; Paul A. Ryan, Osborn Mfg. Co.; C. F. Seelbach, Forest City Foundry Co.; W. C. Sly, W. W. Sly Mfg. Co.; M. J. Sweeney, Allyne-Ryan Foundry Co.; G. H. Wadsworth, Wadsworth Core Machine & Equipment Co., Akron, O.; Lee Wallace, American Ship Building Co., and R. H. West, West Steel Casting Co.

JESSE L. JONES,
President, American Institute of Metals

Ladies' Reception Committee.—Mrs. W. C. Sly, 13474 Lake avenue, chairman; Mrs. H. R. Atwater, Mrs. A. O. Backert, Mrs. H. J. Boggis, Mrs. R. A. Bull, Mrs. J. H. Coleman, Mrs. F. H. Dodge, Mrs. G. W. Fleig, Mrs. B. D. Fuller, Mrs. F. E. Gordon, Miss Edna B. Greene, Mrs. M. C. Sammons, Mrs. J. S. Smith, Mrs. H. W. Wadsworth, Mrs. R. H. West and Mrs. F. B. Whitlock.

Entertainment Committee.—Sterling W. Hubbard, Rogers, Brown & Co., chairman; E. E. Allyne, Aluminum Castings Co.; H. R. Atwater, Osborn Mfg. Co.; J. H. Bruce, Bowler Foundry Co.; C. W. Hotchkiss, National Malleable Castings Co.; H. W. Molder, Best Foundry Co., Bedford, O., and G. M. Walton, Madison Foundry Co.

Molding sand was produced in very much greater quantity in 1915 than in 1914, owing in part at least to the foreign demand for vast supplies of machinery and munitions requiring the casting of metal, which called for the use of molding sand in large amounts. The production of molding sand in the United States was 3,585,746 short tons, valued at $2,123,203.

Program, American Institute of Metals

Monday, Sept. 11, 9:00 a. m.
Registration, mezzanine floor, Hotel Statler.

Monday, Sept. 11, 2:30 p. m., Hotel Statler
Joint opening session, American Foundrymen's Association and American Institute of Metals.

Tuesday, Sept. 12, 10:00 a. m., Hotel Statler
Joint session, American Foundrymen's Association and American Institute of Metals.

Tuesday, Sept. 12, 3:00 p. m.
Ball game, Cleveland vs. Detroit, American League Park.

Tuesday, Sept. 12, 8:15 p. m.
Theater party.

Wednesday, Sept. 13, 10:00 a. m., Hotel Statler
FOUNDRY PRACTICE

"Twenty-Five Years' Experience in the Brass Foundry," by E. A. Barnes, Fort Wayne Electric Co., Fort Wayne, Ind.

"Evolution of the Die Casting Process," by Charles Peck, Doehler Die Casting Co., Rochester, N. Y.

"How a Large Manufacturing Concern Disposes of Its Old Metal," by J. M. Bateman, Western Electric Co., Cleveland.

"The Reclamation of Brass Ashes," by Arthur F. Taggart, Hammond Laboratory, Yale University, New Haven, Conn.

"The Small Leaks of a Brass Foundry," by Charles T. Bragg, Ohio Brass Co., Mansfield, O.

"The Application of the Oxy-Acetylene Welding Process in the Repair of Defective Non-Ferrous Castings," by S. W. Miller, Rochester Welding Co., Rochester, N. Y.

"Alloys to Withstand Internal Air Pressure," by S. D. Sleeth, Westinghouse Air Brake Co., Wilmerding, Pa.

"Making Thin-Walled Castings," by R. S. B. Wallace, National Cash Register Co., Dayton, O.

Wednesday, Sept. 13, 12:00 m.
Ladies' luncheon at the Hotel Statler.

Wednesday, Sept. 13, 1:00 p. m.
Inspection of the Cleveland Furnace Co.'s plant. Sightseeing automobiles will make trips at 30-minute intervals from the Hotel Statler to the blast furnace plant.

Wednesday, Sept. 13, 2:00 p. m.
Ladies' sight-seeing automobile trip.

Wednesday, Sept. 13, 7:30 p. m.
Trip to Euclid Beach, special cars being provided.

Thursday, Sept. 14, 10:00 a. m., Hotel Statler
HEAT-TREATMENT, CORROSION, ETC.

"Deterioration of Muntz Metal," by H. S. Rawdon, United States Bureau of Standards, Washington, D. C.

"The Initial Stress Produced by the Burning-In of Manganese Bronze," by Paul D. Merica and C. P. Karr, United States Bureau of Standards, Washington, D. C.

"A Curious Case of Corrosion of Tinned Sheet Copper," by Paul D. Merica, United States Bureau of Standards, Washington, D. C.

"Notes on the Occurrence and Significance of Twinned Crystals in Electrolytic Copper," by H. S. Rawdon, United States Bureau of Standards, Washington, D. C.

"The Annealing Properties of Copper," by G. V. Caesar and G. G. Gerner, Hammond Laboratory, Yale University, New Haven, Conn.

"Some Uses and Properties of German Silver as Applied to the Optical Trade," by G. C. Holder, American Optical Co., Southbridge, Mass.

Thursday, Sept. 14, 7:00 p. m.
Annual banquet, Hotel Statler.

Friday, Sept. 15, 10:00 a. m.
PHYSICAL TESTS, METALLOGRAPHY, ETC.

"Aluminum Castings and Forgings," by P. E. McKinney, United States Navy Yard, Washington, D. C.

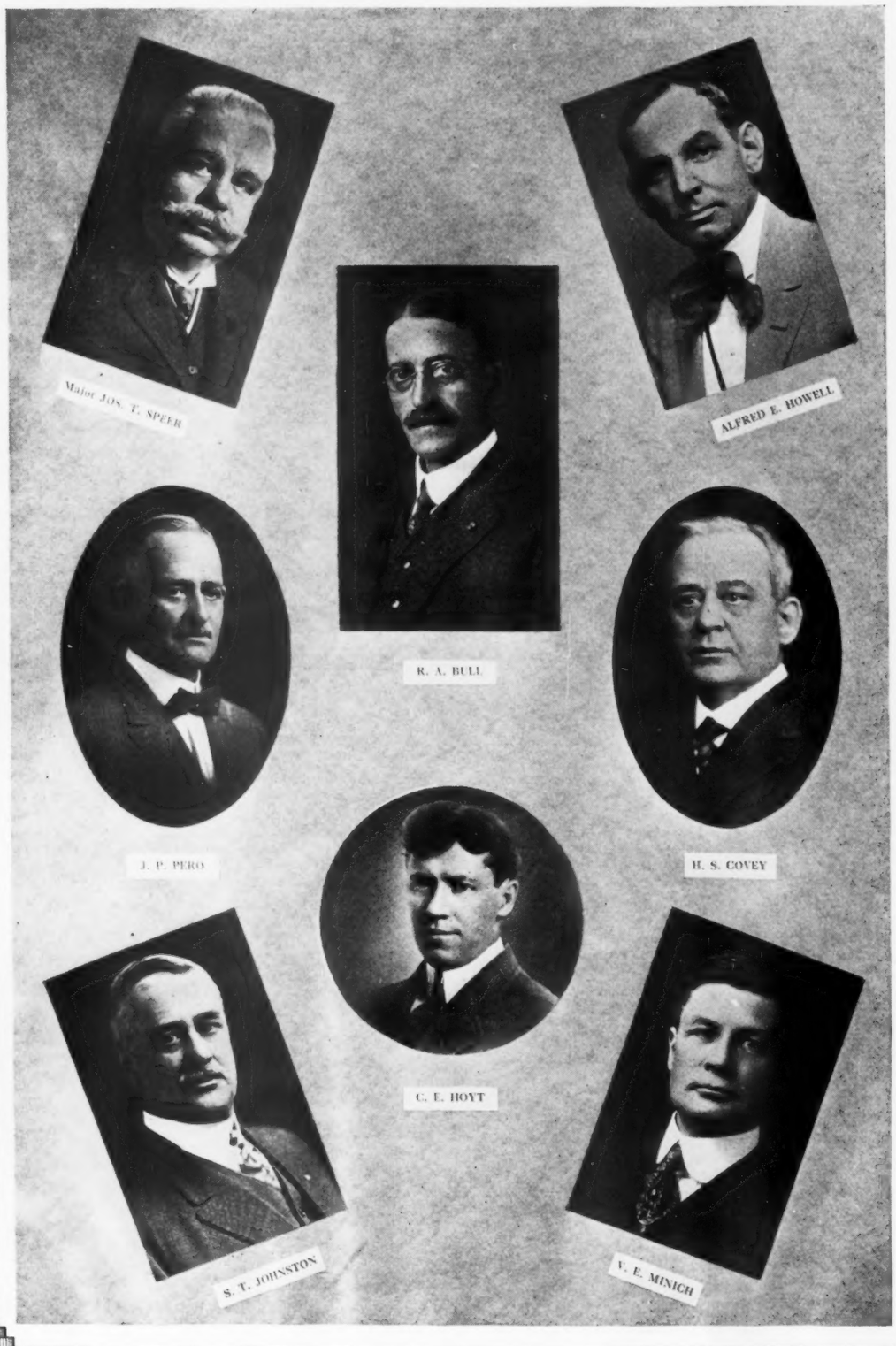
"Copper-Aluminum-Iron Alloys," by W. M. Corse, Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

"Physical Tests on Common High Brass Taken Parallel and at Right Angles to the Direction of Rolling," by William B. Price and Philip Davidson, Scovill Mfg. Co., Waterbury, Conn.

"Seasoning Cracks and the Self-Annealing of Brass," by W. Arthur, Frankford Arsenal, Frankford, Philadelphia.

"Co-operation with the Metal Industries in Metallographic Work," by C. H. Mathewson, director, Hammond Laboratory, Yale University, New Haven, Conn.

F. L. Antisell, Raritan Copper Works, Perth Amboy, N. J., will present a paper, the subject of which is to be announced later.



EXHIBITION COMMITTEE OF AMERICAN FOUNDRYMEN'S ASSOCIATION AND AMERICAN INSTITUTE OF METALS

What You Will See at the Big Foundry Show

A List of the Exhibitors and What They Will Exhibit. Every Device for the Foundry and Machine Shop Will Be On Display and Many Machines Will Be Exhibited

AJAX METAL CO., Philadelphia.—The booth of this company will be fitted up as a reception room in which brass ingots will be exhibited; represented by G. H. Clamer, C. F. Hopkins, F. M. Willeson, C. F. McRae and L. E. Purnell.

ALEXANDER BROS. LUMBER CO., Cleveland.—Pattern and flask lumber will be displayed; represented by M. F. Fitzgerald and H. L. Spitler.

AMALGAMATED MACHINERY CORPORATION, Chicago.—A machine for boring and finishing the inside of large, high explosive shells will be exhibited, as well as a machine frame casting which weighs about five tons. The purpose of the latter exhibit will be to interest foundries equipped to handle such work with a view of making arrangements for additional sources of casting supply. The purpose of this exhibit, primarily, will be to place orders for castings rather than to receive orders for the machines for boring and finishing shells; represented by N. A. Mears.

AMERICAN FOUNDRY EQUIPMENT CO., New York.—Three sizes of sand blast tumbling barrels, one rotary table sand blast room, a sand blast tank outfit and an automatic filling valve will be exhibited; represented by V. E. Minich, H. L. Wadsworth, H. H. Haley, John Bradley and J. D. Alexander.

AMERICAN GUM PRODUCTS CO., New York.—The core binder manufactured by this company, known by the trade name of "Goulac," will be shown and samples of cores made by the use of this binder will be displayed; represented by W. E. Baird and Gordon I. Lindsay.

AMERICAN MOLDING MACHINE CO., Terre Haute, Ind.—A 22-inch jar-ramming machine will be exhibited; represented by Glen B. Hastings and W. C. Norcross.

ARCADE MFG. CO., Freport, Ill.—The following line of molding machines will be shown in operation: Twenty-four-inch power roll-over jar-ramming machine, air squeezer, combination jar-ramming and squeezer molding machine, core jar-ramming machine, special piston molding machine, piston jar-ramming machine, a Modern molding machine and a Norcross jar-ramming machine; represented by E. H. Morgan, Chas. Morgan, L. L. Munn, Henry Tscherning, R. R. Turnbull, August Christen and G. D. Wolfley.

ARMSTRONG CORK CO., Pittsburgh.—Brick for the insulation of furnaces, ovens, boiler settings, hot blast mills and kindred high temperature equipment, will be displayed, as well as high pressure coverings for the insulation of steam lines, boilers, etc. Cork covering for drinking water systems and cold pipes generally, corkboard for cold storage insulating purposes, and "Linotile" for floors, offices, etc., also will be shown; represented by P. W. Lamson and E. C. Lloyd.

ATKINS, E. C., & CO., Indianapolis.—Hack saws, hack saw frames and metal cutting saws for all purposes will be shown; represented by T. H. Endicott, Thos. A. Carroll and A. Mertz.

AYER & LORD TIE CO., Chicago.—This exhibit will show an installation of creosoted wood blocks for shop floors and a large number of photographs also will be displayed illustrating shop floors in various industrial plants; represented by B. S. McConnell, S. C. Conway, R. G. Inslee, W. H. Blythe, F. W. Maechler and A. H. Noyes.

B. & B. MFG. CO., Indianapolis, Ind.—A molding machine exhibit will be made which will consist of the following: One 30-inch hand jar-ramming and squeezer molding machine of the stationary type; one 30-inch power machine with a 12-inch power unit of the portable type, and one 24-inch stationary power machine with a 10-inch power unit; represented by W. J. Parker, E. E. Yemary and B. V. Selby of the Cleveland Power Transmission Co., Cleveland.

BEIGHLEE ELECTRIC CO., Cleveland.—Recording and indicating pyrometer equipment for all classes of foundry work will be shown; represented by W. O. Little and W. H. Chappel.

BERKSHIRE MFG. CO., Cleveland.—The extensive line of molding machines manufactured by this company will be shown in operation, including one of the automatic type, hand and power squeezers and universal squeezers. Other foundry accessories also will be exhibited, such as vibrators, knee-valves and miscellaneous foundry equipment; represented by R. H. York, W. D. Fraser, G. L. Cannon, F. Hulec and George Allen.

BESLY, CHARLES H., & CO., Chicago.—All of the equipment to be displayed will be operated and will consist of a direct-connected, motor-driven pattern maker's disc grinder, a belt-driven, vertical spindle disc grinder, a direct-connected disc grinder and a belt-driven, wide face ring wheel grinder. Abrasive discs and samples of work that can be done on these disc grinders will be shown; represented by E. P. Welles, Chas. A. Knill, R. W. Young, George Klemp and L. E. Jacobs.

BIRKENSTEIN, S., & SONS, Chicago.—Brass foundry alloys in ingot form will be displayed, as well as castings made from these metals; represented by Harry Birkenstein, Lee Kahn, M. Schero, H. Goldstine and Charles Raphael.

BLYSTONE MFG. CO., Cambridge Springs, Pa.—The core sand mixer with screen and motor attached, built by this company, will be shown in operation and in addition, these mixers will be equipped with a power dump. This consists of a cone-shaped plate attached to one end of the main mixing shaft, into which a disc is thrown by the use of a lever. Connected with this disc is a sprocket wheel used to tilt the drum. On the opposite side of the sprocket wheel is another disc and cone-shaped plate used to hold the drum in any position desired. This disc and plate are brought together by the same lever. The drum is placed in position when both discs are in neutral; represented by W. J. Pees and Luther G. Conroe.

BROWN HOISTING MACHINERY CO., Cleveland.—A hand traveling crane will be shown as well as tramrail equipment with switch and turn-table and an I-beam trolley with hoists. All of this equipment will be erected for complete operation; represented by A. R. Leeds and F. D. Johnson.

BROWN SPECIALTY MACHINERY CO., Chicago.—Three sizes of core-making machines, both electric and pneumatic; duplex shakers and a revolving barrel sand-blast machine will be shown; represented by E. A. Rich Jr., John Laycock and J. E. Sweet.

CARBORUNDUM CO., Niagara Falls, N. Y.—The extensive line of refractory products manufactured by this company, including carborundum and aloxite wheels for foundry use, carborundum fire sand and silicon metal for the iron and steel trade will be exhibited; represented by Geo. R. Rayner, G. T. Estabrook, W. U. Parrott, C. W. Bardon, W. Walters, C. D. Sargent, C. C. Dobson, J. P. McCann, T. B. Woodrow and C. E. Hawke.

CATARACT REFINING & MFG. CO., Buffalo.—Core oils, core compounds, parting compounds, cutting lubricants, cutting compounds, cutting oils, together with samples of cores, castings, etc., made with the material manufactured by this company will be exhibited; represented by J. Purvis Jr., J. E. Chism, E. P. Hughes, D. L. Baldwin, A. A. Schaefer, A. C. Breese, R. M. Hitch, W. E. Williams, F. N. Tweedy, E. H. Coburn, C. W. Seibold, B. Deacon, H. C. Newton, T. E. Kenefick and H. C. Hutchins.

CHAMPION FOUNDRY MACHINERY CO., Chicago.—Four electrically-driven sand riddles will be shown in operation; represented by Wm. Magnuson, A. Magnuson and H. O. Magnuson.

CHICAGO EYE SHIELD CO., Chicago.—Eye shields, shades and goggles for use in industrial plants will be exhibited; represented by Robert Malcolm.

CHICAGO PNEUMATIC TOOL CO., Chicago.—This display will consist of pneumatic chipping hammers, pneumatic rammers, pneumatic hoists, compressors, drills, pneumatic casting cleaners and electric drills and grinders; represented by A. C. Andresen, T. D. Slingman, T. G. Smallwood, J. G. Osgood.

CINCINNATI PULLEY MACHINERY CO., Cincinnati.—An operating exhibit will be made of machine tools, consisting of the following: Single spindle No. ¼, Avey high speed ball bearing drill press of the column type, arranged for motor drive; single spindle No. 1¼, Avey high speed ball bearing drill press of the column type, arranged for motor drive; two-spindle, No. 2½, Avey high speed ball bearing drill press of the column type with pump, arranged for motor drive; single spindle, No. 2½, Avey high speed ball bearing drill press; single spindle, No. 1 Avey high speed ball bearing drill press and a No. 3, single spindle Avey high speed ball bearing drill press of the round column type, equipped with power feed; represented by L. B. Patterson, J. G. Hey, J. F. Mirrieless and C. K. Kairns.

CLARK, CHAS. J., Chicago.—Blast meters and a complete line of instruments for measuring the volume and pressure of blast supplied to cupolas, malleable furnaces, etc., will be displayed; represented by Charles J. Clark.

CLEVELAND BLOW PIPE & MFG. CO., Cleveland.—A dust collecting system for the removal of dust from grinding and emery wheels will be exhibited. This system will consist of a motor-driven exhaust fan, dust trap, galvanized steel piping and hoods of various designs. A sheet metal shower bath with plumbing attachments also will be displayed; represented by E. Coney.

CLEVELAND PNEUMATIC TOOL CO., Cleveland.—A variety of sizes of all types of air tools, manufactured by this company, will be displayed. This includes riveting hammers,

a complete assortment of chipping hammers with outside and inside latch, portable air grinders, corner drills, compound drills, center spindle drills of the four-piston type, breast drills of the four-piston type, breast drills of the rotary type, core breakers, oscillating valve grinders, etc. Sample tools of all kinds will be shown in operation. Air hose couplings in all sizes from ¼ to 1½-inches, clamps and plain and armored air hose also will be displayed; represented by H. S. Covey, L. W. Greve, Arthur Scott, Geo. H. Hall, Joseph T. Graves, W. L. Orton and J. De Mooy.

CLEVELAND WIRE SPRING CO., Cleveland.—Steel shop barrels and boxes will be exhibited; represented by J. W. Campbell, C. H. Erickson, J. B. Marshall and C. C. Klingman.

COALE, THOMAS E., LUMBER CO., Philadelphia.—An extensive display of pattern lumber will be made to consist of Michigan soft cork white pine and genuine California sugar pine; represented by Thomas E. Coale, E. C. Anderson, A. Warren Anderson and James Wood.

CURTIS PNEUMATIC MACHINERY CO., St. Louis.—A controled, splash-oiling system air compressor with adjustable sight feed cylinder lubrication will be operated and other equipment to be displayed will include a vertical air hoist of the reciprocating type which automatically raises and lowers the load for a movement of a few inches at the bottom of the stroke for washing and pickling operations, thus requiring no attention on the part of the operator until he sets the valve either to stop the action or to raise the load out of the solution; a single I-beam crane for either foundry or machine shop use; a closed hopper sand-blast; a single I-beam trolley and small compressors. A large number of photographs also will be displayed showing representative installations of the pneumatic elevators and foundry equipment manufactured by this company; represented by L. C. Blake and members of the firm of the Charles E. Stamp Co., Cleveland representative of the Curtis Pneumatic Machinery Co.

DALTON ADDING MACHINE CO., Cincinnati.—Adding, listing and computing machines will be exhibited; represented by R. L. Smith, D. C. Boyer, A. J. Anderson and A. S. Harris.

DAVENPORT MACHINE & FOUNDRY CO., Davenport.—This manufacturer of molding machines will have a booth fitted up as a rest room for visiting foundrymen and photographs will be displayed showing his extensive line of labor-saving molding devices; represented by John T. Anderson, A. D. Ziebarth and Carl Falk.

DAVIS BOURNONVILLE CO., Jersey City, N. J.—An operating exhibit will be made of oxy-acetylene and oxy-hydrogen welding and cutting apparatus, showing the practical application of these processes in foundry work for general repairs and for manufacturing. This exhibit will include stationary acetylene pressure generators with welding and cutting stations for shop or foundry equipment, portable welding units, portable cutting units, the oxygraph and radiagraph for cutting steel plates and billets from ¼ to 20-inches or more thick, standard types of welding and cutting torches, pressure regulators, welding supplies, etc.; represented by H. H. Dyar, H. A. Lindholm, H. Gill, Wm. H. Joyce and Alex. Blazer.

DEMMLER, WM., & BROS., Kewanee, Ill.—The automatic coremaking machine built by this company will be shown in operation; represented by H. L. Demmler.

DIXON, JOSEPH, CRUCIBLE CO., Jersey City, N. J.—A complete line of graphite products, including crucibles, stoppers, nozzles, sleeves, phosphorizers, stirrers and foundry facings will be displayed; represented by Dudley A. Johnson, H. C. Sorenson, F. R. Brandon and J. A. Biel.

ELECTRIC CONTROLLER & MFG. CO., Cleveland.—The applications of lifting magnets and automatic machine tool controls will be illustrated by a stereopticon; represented by F. R. Fishback, M. Converse and W. H. Beatty.

EXCELSIOR TOOL & MACHINE CO., East St. Louis, Ill.—Two automatic polishing machines will be shown in operation. The one will be engaged in polishing a stove top, while the other will polish pipe. A combination polishing and buffing lathe also will be shown; represented by T. F. Philippi.

FEDERAL FOUNDRY SUPPLY CO., Cleveland.—An extensive display of foundry equipment will be made, including jolt-ramming molding machines, power squeezers, combination jolt-ramming and squeezer machines, snap flasks, pouring devices and electric riddles. Foundry facings and supplies also will be shown; represented by W. J. Adams, Ralph Ditty, John Bayer, L. H. Heyl, C. Collins, John Mertes, E. Kaye, I. D. Adams and W. J. Smith.

FELT & TARRANT MFG. CO., Chicago.—Adding and calculating machines will be shown and the advantages of these machines in accounting work will be demonstrated; represented by William F. Sims.

FOUNDRY EQUIPMENT CO., Cleveland.—This exhibit will include stationary core ovens of the roller drawer type, brass and aluminum furnaces, sprue cutters, squeezers, crucible lever lifters, oil burners and coremakers' benches; represented by Julius Tuteur, F. A. Coleman and C. A. Barnett.

THE FOUNDRY, Cleveland.—This booth will be fitted up as a rest room for visiting foundrymen and a display will be made of artistic gray iron castings which have been collected in all parts of the world; represented by A. O. Backert, George Smart, H. Cole Estep, J. D. Pease, R. V. Sawhill, E. C. Kreutzberg, A. L. Klingeman, L. C. Pelott, S. H. Jasper, A. W. Howland and F. V. Cole.

GARDNER MACHINE CO., Beloit, Wis.—Belt and motor-driven disc grinders as well as samples of work done on disc grinding machines, will be displayed; represented by L. W. Thompson, F. E. Gardner, E. B. Gardner, W. B. Leishman, J. M. Gardner, D. C. Graves, W. L. Townsend and E. L. Beisel.

GENERAL ELECTRIC CO., Schenectady, N. Y.—An extensive display will be made of controling devices, switchboards, panels, motors and a 300-ampere, portable arc welding outfit. Among the equipment included in this exhibit are the following: One centrifugal compressor set, operated by a 4-horsepower, three-phase 60-cycle, 220-volt motor; one 5-inch blast gate; one oil switch with overload relays for use with centrifugal compressor set; controllers of various types, numerous panels and rheostats as well as a number of motors of various types and sizes.

GIBB INSTRUMENT CO., Pittsburgh.—A pyrometer for high temperature measurements will be displayed; represented by J. R. Brueckner.

GISHOLT MACHINE CO., Madison, Wis.—The periodograph, which is an instrument whereby the accurate time on the job records of the workmen, both in foundries and machine shops, is obtained, will be exhibited. It gives accurate figures on which to base cost records and provides a means of assisting the foremen in routing production. The device will be demonstrated in operation and its application to various factory conditions and the benefits to be derived from it, will be pointed out; represented by W. J. Hanum, Robert M. Carter, Howard E. Preston, Ellis F. Muther and Charles B. Carr.

GOLDSCHMIDT THERMIT CO., New York.—The complete line of various carbon-free metals manufactured by this company will be exhibited and samples of 50 per cent ferro-silicon, manufactured by the Keokuk Electric Metals Co., Keokuk, Ia., will be shown. Samples of thermit welds on heavy sections of wrought iron and steel will likewise be exhibited and the process will be illustrated by numerous large photographs of modern welds made on rolling mill housings, pinions, rolls, blooming mill shears, crankshafts and similar sections. This exhibit also will include a complete line of thermit and titanium thermit cans for use in molten metal in foundry ladles. Demonstrations of pipe welding also will be made throughout convention week; represented by D. B. Browne, H. G. Spilsbury, J. G. McCarty, H. D. Kelley and E. B. Bloom.

GORDON SAND CO., Conneaut, O.—The booth to be occupied by this company will be fitted up as an office and rest room; represented by F. E. Gordon, U. E. Kanavel, W. R. Thompson and H. A. Keener.

GRACETON COKE CO., Graceton, Pa.—The foundry coke manufactured by this company will be exhibited; represented by C. M. Lingle.

GREAT WESTERN MFG. CO., Leavenworth, Kas.—Two types of gyratory foundry riddles, manufactured by this company, will be shown in operation, one being equipped with a rectangular no-dump sieve for continuous riddling. Another riddle for contractors' use, provided with a large sieve also will be shown; represented by F. A. Pickett and Geo. W. Combs.

HARDY, F. A., & CO., Chicago.—Safety goggles for use in general industrial operations, welding glasses, eye protectors, respirators and welding helmets will be displayed; represented by C. S. Wells and W. B. Gosman.

HARRIS, BENJ., & CO., Chicago.—Different grades of brass ingots, as well as castings made by brass foundrymen from this company's products will be shown; represented by N. and O. Harris and L. Goldman.

HAUCK MFG. CO., Brooklyn, N. Y.—Compressed air and hand pump cupola lighters, skin-drying outfits, kerosene torches, core oven burners, ladle heaters, rivet-forges, blacksmith and brazing forges and an aluminum melting furnace, will be exhibited; represented by Arthur E. Hauck, A. Busch Hauck and A. P. Link.

HAYWARD CO., New York. — Electric motor clam shell bucket, two-line clam shell buckets, two-line orange peel buckets and drag scraper buckets will be displayed; represented by C. F. Hutchings and H. M. Davison.

HERMAN PNEUMATIC MACHINE CO., Zelienople, Pa.—A small jar-ramming machine will be shown; represented by A. M. and H. T. Frauenheim, Alfred Herman, Andrew Rogers, R. P. Morgan, Robert Walker, Robert Ringle and Thos. Kaveny.

HEROLD BROTHERS CO., Cleveland.—A complete line of brushes for the foundry trade will be shown, including bristle, horse hair Tampico, and welded wire circular brushes; represented by A. B. Herold, Leon T. Herold, R. C. Herold and H. G. Schlueter.

HILL & GRIFFITH CO., Cincinnati.—An electrically-operated sand riddling machine will be exhibited; represented by Wm. Oberhelman, F. McCarthy, J. M. Glass and James A. Carey.

HILL-BRUNNER FOUNDRY SUPPLY CO., Cincinnati.—Samples of the extensive line of foundry facings manufactured by this company, will be displayed and the booth

will be fitted up as an office and rest room; represented by John Hill, Fred Brunner and Bruce Hill.

HOEVEL MFG. CORPORATION, New York.—The booth of this manufacturer of sand-blast machines will be fitted up as a rest room for visiting foundrymen and a large number of photographs will be displayed, showing sand-blast installations made in many plants throughout the United States; represented by H. F. Hoevel, F. W. Weiss and L. B. Passmore.

HOLZ, HERMAN A., New York.—The Brinell meter which is a portable apparatus for the accurate and convenient determination of the hardness of metals and metal products, independent of the dimensions, shape and location of the test, will be exhibited; represented by W. C. Little.

IMPERIAL BRASS MFG. CO., Chicago.—Welding, cutting and decarbonizing appliances, manufactured by this company, will be displayed; represented by Frank McNellis, J. Schroeter, J. Meskin and Chas. E. Young.

INGERSOLL-RAND CO., New York.—This exhibit will consist of pneumatic sand rammers; five sizes of air motor hoists in capacities from ½ to 5 tons; chipping, calking and scaling hammers; core breaker; pneumatic grinder for smoothing, cleaning, polishing and buffing castings; reversible and non-reversible drills for reaming, tapping, flue-rolling and stud-seating; close quarter drills; five sizes of riveting hammers, with and without safety retainer and of both inside and outside trigger pattern; jam riveters for riveting in confined spaces; holder-ons for backing-up rivets; chipping hammers in a wide range of sizes and a pneumatic core-breaking hammer. This company will also have on exhibition a 12 and 7½ by 12 duplex air compressor, short belt-driven by a 62-horsepower General Electric motor. This compressor will be one of several that will furnish air for operating the various exhibits of pneumatic machinery; represented by W. A. Armstrong, Geo. A. Gallinger, Walter A. Johnson, J. E. Kemmerling and Geo. C. Williams.

INTERNATIONAL MOLDING MACHINE CO., Chicago.—The extensive line of molding machines built by this company will be exhibited; represented by Edward A. Pridmore, W. W. Miller, J. W. Dopp, and F. W. Hamel.

INTERSTATE SAND CO., Zanesville, O.—Samples of molding sands for gray and malleable iron, steel and brass foundries will be exhibited.

THE IRON TRADE REVIEW, Cleveland.—This booth will be fitted up as a rest room for visiting foundrymen and a display will be made of artistic gray iron castings which have been collected in all parts of the world; represented by A. O. Backert, George Smart, H. Cole Estep, J. D. Pease, R. V. Sawhill, E. C. Kreutzberg, A. L. Klingeman, L. C. Pelott, S. H. Jasper, A. W. Howland and F. V. Cole.

JENNISON-WRIGHT CO., Toledo, O.—This display will consist of several types of factory floor blocks designed to meet conditions in machine shops, foundries, pickling rooms, annealing rooms, forge shops, driveways, platforms, etc.; represented by H. G. Jennison, W. E. Wright, F. W. Cherrington, E. M. Humphrey, H. P. Consaul and A. W. Cobley.

KAWIN, CHAS. C., CO., Chicago.—This firm of chemists and metallurgists will have a booth equipped as an office and rest room for the convenience of its large number of customers and friends; represented by Charles C. Kawin, J. F. Nellis, R. J. Courtney and J. H. Hopp.

KING, JULIUS, OPTICAL CO., New York.—Safety eye protectors, respirators, masks, helmets and all devices designed for the protection of the eyes, will be shown. Danger signs and signals also will be displayed and a demonstration will be made of colored lenses, while stereoptican views of broken goggles will be thrown on a screen; represented by J. J. Duffy.

LAKE ERIE SMELTING & REFINING CO., Cleveland.—An extensive display will be made of the brass alloys, in ingot form, manufactured by this company; represented by L. B. and E. A. Stoddard.

LAKEWOOD ENGINEERING CO., Lakewood, O.—Industrial cars for use in foundries, machine shops and manufacturing plants will be shown.

LEES-BRADNER CO., Cleveland. — Gear and thread cutters will be displayed.

LEHIGH COKE CO., South Bethlehem, Pa.—The foundry coke manufactured by this company will be exhibited; represented by D. A. Barkley and Robt. MacDonald.

LIFE SAVING DEVICES CO., Chicago.—Lungmotors for use in asphyxiation by gases, electric shocks, drowning, etc., will be displayed. This safety device has been installed by many industrial plants including foundries, steel works, etc.; represented by J. M. Booher, Frank T. Fowler and Louis D. Jones.

LINCOLN ELECTRIC CO., Cleveland.—A 300-ampere arc welder will be exhibited; represented by Robert E. Kinkead.

LUCAS MACHINE TOOL CO., Cleveland.—A 50-ton power forcing press, suitable for straightening heavy malleable iron castings, will be exhibited; represented by J. A. Leighton Jr. and F. P. Sprague.

LUPTON'S, DAVID, SONS CO., Philadelphia.—An exhibit will be made of special sash to provide light and ventilation in industrial buildings; represented by Clarke P. Pond.

MACLEOD CO., Cincinnati.—This exhibit will consist of sand-blast tumbling barrels, sand-blast hose machine, portable oil burners, dust arresters and oxy-acetylene welding and cutting apparatus; represented by Walter Macleod, O. P. Gwinner and Gus Schmidt.

MAHR MFG. CO., Minneapolis.—Portable foundry torches and a portable oil burning rivet forge will be exhibited; represented by J. A. Mahr, F. N. Brooker and F. A. Davis.

MALLEABLE IRON FITTINGS CO., Branford, Conn.—A complete line of vibrators, from ⅜ to 2 inches, inclusive, will be exhibited as well as a new line of accessories, such as valves, fittings and clamps suitable for the installation of vibrators on molding machines; represented by G. B. Pickop and J. C. Page.

MANITOWOC ELECTRIC IMPLEMENT CO., Manitowoc, Wis.—Electric plate, bench and tub vibrators for foundry use will be displayed; represented by Frank Brixius and R. Stockings.

McCORMICK, J. S., CO., Pittsburgh.—A grinding pan for grinding and mixing foundry sands, gyratory riddle, core plates, and a general line of foundry supplies will be exhibited; represented by J. S. McCormick, T. E. Malone, S. R. Costley, and A. T. Richardson.

MICHIGAN SMELTING & REFINING CO., Detroit.—Samples of ingot brass with the cast product made therefrom, will be shown. Lead pipe, solders, babbitt metals, etc., also will be exhibited; represented by Jos. Sillman, C. O. Patch, Henry Levitt, A. J. Hall, Wm. J. Schweitzer, A. J. Oates, J. D. LeBel, H. D. LeBel, H. E. Berliner and R. H. Evans.

MIDLAND MACHINE CO., Detroit.—The molding machines to be exhibited will be shown in operation and will include a jolt-ramming roll-over pattern-drawing machine, provided with a special car for delivering the molds to the floor and one hand roll-over molding machine; represented by G. L. Grimes, E. L. Grimes, L. V. Grimes and C. J. Skeffington.

MOLDAR CO., Maspeth, N. Y.—The roller-ramming molding machine built by this company will be shown in operation; represented by George M. Etzel.

MOLTRUP STEEL PRODUCTS CO., Beaver Falls, Pa.—Steel pattern plates of various sizes and shapes and plates with patterns mounted will be displayed and in addition, the following steel products, manufactured by this company will be exhibited: Finished machine keys of all kinds, cold drawn steel bars and a finished machine rack; represented by F. H. Guppy and N. S. Leyda.

MONARCH ENGINEERING & MFG. CO., Baltimore.—This extensive exhibit will consist of a battery of core ovens of various types for operation with oil, gas, coal or coke for fuel. Melting furnaces for the brass foundry also will be displayed, including a stationary oil furnace, tilting oil furnace, tilting coke furnace, Simplex and one double chamber furnace. The latter two furnaces are used for melting brass and non-ferrous metal alloys without crucibles; represented by H. D. Harvey, James J. Allen, W. Raber and F. Maujean.

MOTT SAND BLAST MFG. CO., Chicago.—Sand-blast machines will be exhibited.

MULTI-METAL SEPARATING SCREEN CO., New York.—Sand-blast helmets, dust hoods, acid masks, babbitting masks and respirators will be shown; represented by Frederick Stern.

MUMFORD, E. H., CO., Elizabeth, N. J.—An extensive display of molding machines will be made, including plain and combination split pattern machine; plain and combination squeezers, plain jar-rammers, plain squeeze-ramming split pattern machines, combination jar-ramming and squeezer-ramming split pattern machines, plain power squeezers, and combination jar-ramming and squeezer molding machines; represented by T. J. Mumford 2nd, and H. W. Sinclair.

MUMFORD MOLDING MACHINE CO., Chicago.—A 10-inch high trunnion squeezer will be exhibited, as well as other molding machines manufactured by this company; represented by James T. Lee, Donald Alexander, Otto F. Weiss, W. M. Whyte, Lewis R. Palmer and Arthur F. Jensen.

NATIONAL ENGINEERING CO., Chicago.—A foundry mixer will be shown in operation; represented by P. L. Simpson.

NEW HAVEN SAND-BLAST CO., New Haven, Conn.—A sand-blast rolling barrel and several sizes of hose type machines will be shown in operation and accessories used in sand-blast operations also will be displayed; represented by C. E. Billings, C. S. Johnson, and Chas. A. Dreisbach.

NORMA COMPANY OF AMERICA, New York.—A complete line of precision ball, roller, thrust and combination bearings will be displayed; represented by E. A. Perkins and O. P. Wilson.

NORTON CO., Worcester, Mass.—An attractive display will be made of grinding wheels for use in foundries; grinding machines of the bench and floor type; a new model protection and dust-hood and a late type of bench grinding machine will be operated; represented by Carl F. Dietz, A. R. Sandine and R. O. Anderson.

OBERMAYER, S., CO., Chicago.—A new type of molding machine, especially adapted for automobile work, will be displayed; represented by S. T. Johnston, E. D. Frohman, J. E. Evans, O. C. Olson, F. H. Dodge, Wm.

Fenton, O. J. Peterson, C. M. Barker and Wm. Fitzpatrick.

OLIVER MACHINERY CO., Grand Rapids, Mich.—An extensive display will be made of machinery for the pattern shop, which will be shown in operation. The exhibit will include a universal wood milling machine; ball bearing jointer, provided with new safety features and easy operating devices; universal saw bench; vertical spindle and disk sander, equipped with ball bearings and single pulley motor drive arrangement; motor-driven heavy duty engine lathe; and a 14-inch heavy duty turret lathe and 1½-inch screw machine; represented by A. S. Kuekjian, R. F. Baldwin, M. D. Baldwin, A. Blake, J. R. Duthie, T. J. Piers and Herbert Walsh.

OSBORN MFG. CO., Cleveland.—The line of molding machines, manufactured by this company will be exhibited; including roll-over jar-ramming machines, stripping plate jar-ramming machines, split pattern machines; air squeezers, stripping plate machines and plain jar-ramming machines; represented by H. R. Atwater, E. T. Doddridge, M. W. Zeman, J. C. Alberts, E. W. Jacobi and A. J. Goss.

OXWELD ACETYLENE CO., Chicago.—A complete Oxweld welding and cutting outfit will be shown in operation; represented by E. E. Radcliffe.

PANGBORN CORPORATION, Hagerstown, Md.—This booth will be fitted up as a rest room for visiting foundrymen and numerous photographs will be displayed showing various sand-blast installations made by this company.

PAXSON, J. W., CO., Philadelphia.—An exhibition will be made of Zippler tuyeres; represented by H. M. Bougher and Messrs. Zippler and Kremer.

PHOENIX MFG. CO., Eau Claire, Wis.—This exhibit will consist of turret lathe heads and other machine tool accessories; represented by W. L. Harrison.

PICKANDS, BROWN & CO., Chicago.—Solvay foundry and crushed coke will be displayed in the form of a reproduction of a portion of Commodore Perry's frigate. The forward portion of the hull will be reproduced in coke and the model will be about 15 feet long and 5 feet high, which will point diagonally across the booth. The effect of the water will be displayed in the arrangement of various sizes of crushed coke; represented by B. T. Bacon, E. A. Bateman, A. B. Hawes, J. A. Galligan, T. W. Glasscot and F. T. Lovering.

PITTSBURGH CRUSHED STEEL CO., Pittsburgh.—Samples of all sizes of angular grit, which is a metallic abrasive for sand-blast machines will be displayed, and a concrete hardener and facing also will be shown; represented by G. H. Kann.

PORTAGE SILICA CO., Youngstown, O.—A complete line of samples of steel molding, sand-blast and core sand will be exhibited as well as several large pieces of the natural rock in which these sands are contained will be shown. A large number of photographs showing the extensive plant of the Portage Silica Co., also will be displayed; represented by E. E. Klooz, C. M. Bixler and L. R. Farrell.

PREST-O-LITE CO., Indianapolis, Ind.—Welding and cutting apparatus will be exhibited.

PRIDMORE, HENRY E., Chicago.—The extensive line of molding machines built by this company will be shown in operation and attention will be directed to the new features of the power squeezer, power rock-over drop and combination jar-ramming machines; represented by Mrs. Henry E. Pridmore, Harry A. Pridmore, Charles H. Ellis, D. F. Eagon and A. V. Magnuson.

ROBESON PROCESS CO., New York.—Glutrin, the core binder manufactured by this company, will be exhibited; represented by Geo. N. Moore, T. J. Ryan and R. S. Hughes.

ROGERS BROWN & CO., Cincinnati.—An extensive exhibit of samples of pig iron and coke will be made, together with castings of special interest to foundrymen; represented by Standish Meacham, F. W. Miller, F. W. Bauer, A. J. Wentworth, W. H. Knight, S. W. Hubbard, Harwood Wilson, T. A. Wilson, W. P. Cheney, A. F. Stengle, F. J. Waldo, F. E. Fitts, H. W. Fernald, R. W. Clark, Otto Arlt, Cecil Bertie, G. R. Sullivan, A. O. Sonne, L. C. Calkins and J. C. Mears.

SAND MIXING MACHINE CO., New York.—A sand mixing machine built by this company, which is electrically-driven, will be shown in operation; represented by V. E. Minich, H. H. Haley, John Bradley, J. D. Alexander and H. L. Wadsworth.

SEARCHLIGHT CO., Chicago.—Oxy-acetylene welding and cutting equipment will be exhibited. Demonstrations will be made to show the work of this welder as applied to foundry operations, involving the welding of broken castings and the repair of defective castings. Demonstrations of cutting by the oxy-acetylene process also will be made; represented by R. A. Sossong, H. L. Jillson and P. A. North.

SIPP MACHINE CO., Paterson, N. J.—Quick change speed sensitive drill presses will be displayed; represented by C. A. Wickner.

SLY, W. W., MFG. CO., Cleveland.—A complete line of foundry equipment will be shown including cleaning and resin mills, two sand blast mills in connection with a dust arrester, core oven, rotary table and a large number of photographs of installations of equipment made by this company; represented by W. C. Sly, Geo. J. Fanner, R. J. Emerich, and P. W. Graue.

SMITH FACING & SUPPLY CO., Cleveland.—Foundry facings and supplies will be shown and the booth will be fitted up as a rest room; represented by J. S. Smith, George W. Fleig and Ray Fleig.

SMITH, R. P., SONS CO., Chicago.—This exhibit will consist of safety congress shoes for molders and foundrymen; represented by J. B. Smith Jr.

SMITH, WERNER G., CO., Cleveland.—Core oils, cores made by the use of these oils as a binder, as well as castings produced by such cores will be exhibited; represented by Milton S. Finley, John C. DeVenne, Louis F. Ferster and Werner G. Smith.

SNYDER ELECTRIC FURNACE CO., Chicago.—This booth will be fitted up as a rest room.

STANDARD SAND & MACHINE CO., Cleveland.—On account of the heavy demand for its line of sand-mixing and preparing machines, the Standard Sand & Machine Co. is unable to make an exhibit of its equipment, but photographs of this line of machines will be displayed as well as blue prints showing numerous installations; represented by Harvey E. Boughton, P. E. Lacey and George R. Lawrence.

STERLING WHEELBARROW CO., West Allis, Wis.—An extensive line of steel foundry flasks and wheelbarrows, manufactured by this company will be exhibited, as well as foundry specialties, such as skim gates, wedges, pins, etc.; represented by I. R. Smith, H. H. Baker, J. J. Coyne, J. M. Dickson, E. W. Dowd, Geo. Lambkin and Chas. L. Kirk.

STEVENS, FREDERIC B., Detroit.—A varied line of foundry facings, core compounds, buffing compositions, etc., will be shown and a display will be made of stamped steel ladle bowls and cast band shanks; represented by Frederic B. Stevens, W. J. Cluff, J. M. Mayers, James F. Hughes, Jos. M. Johnston, Henry Krigner, D. D. Baxter and Thos. E. LaMondy.

STODDER, W. F., Syracuse, N. Y.—A suction sand-blast nozzle for cleaning iron, steel and brass castings will be displayed; represented by W. F. Stodder.

STRONG-KENNARD & NUTT CO., Cleveland.—A complete line of protection goggles, including models for grinding, chipping, polishing, welding and other industrial uses will be shown and a display will be made of respirators and masks for electric welding. The strength of the lenses used in these goggles will be demonstrated by an interesting drop test and the method of determining color values in welding lenses also will be revealed; represented by B. W. Nutt and Richard Cook.

SULLIVAN MACHINERY CO., Chicago.—An air compressor will be shown in operation; represented by M. S. Sloman.

SUPERIOR SAND CO., Cleveland.—Samples of various grades of molding sand for the production of aluminum, brass, gray iron, malleable iron and semi-steel castings will be shown; represented by W. H. Smith, H. C. Koontz, and W. J. Sallee.

THOMAS ELEVATOR CO., Chicago.—The line of quick-acting chucks manufactured by this company will be displayed.

TITANIUM ALLOY MFG. CO., Niagara Falls, N. Y.—Ferro carbon-titanium used in the manufacture of steel and iron, and various bronze, brass and titanium-aluminum bronze castings, will be exhibited: representatives of the ferro-carbon-titanium department, H. H. Cook, A. C. Hawley and W. J. Evans; representatives of the bronze department, W. M. Corse, H. R. Corse and C. Vickers.

UNION STEAM PUMP CO., Battle Creek, Mich.—The extensive line of air compressors, built by this company, will be shown in operation, including one 8 x 9 x 8-inch enclosed type, high speed, splash-lubricated, steam-driven compressor; one 8 x 8-inch enclosed type, splash-lubricated, short belt-driven air compressor; one 8 x 6-inch vertical duplex, high speed, splash-lubricated, short belt-driven air compressor and one 3½ x 4-inch, splash-lubricated short belt-driven compressor. Several small vertical compressors and steam pumps also will be shown; represented by C. A. Stuck and K. D. Smith.

U. S. GRAPHITE CO., Saginaw, Mich.—This booth will be fitted up as a rest room; represented by H. F. Gump, W. W. Lampkin and R. A. Corrigan.

U. S. MOLDING MACHINE CO., Cleveland.—The extensive line of molding machines to be exhibited by this company will be shown in operation and will include a plain squeezer, a plain jar-ramming machine, a combination jar-ramming machine and squeezer, a combination jar-ramming squeezer and pattern-drawing machine, a combination jar-ramming squeezer, roll-over, pattern-drawing machine, a combination jar-ramming pattern-drawing machine and a combination jar-ramming roll-over pattern-drawing machine; represented by J. N. Battenfeld, C. F. Battenfeld and J. F. Jirka.

UNITED STATES SILICA CO., Chicago.—An exhibit will be made of flint shot sand-blast sand which is manufactured by disintegrating St. Peter's rock, found in the state of Illinois; represented by A. V. Foster and H. S. Goebig.

WADSWORTH CORE MACHINE & EQUIPMENT CO., Akron, O.—An extensive line of equipment for the core room will be shown in operation, including stock core machines, all steel reinforced core trays and bottom plates, a jar-ramming roll-over, box-

(*Continued on page 372*)

How Sand-Blast is Used in Modern Foundries

This Great American Invention Has Revolutionized Cleaning Room Practice —Many Types of Apparatus Now Are Available for All Classes of Work

By H Cole Estep

THE WEEDS grew tall in the southwest corner of Robinson's foundry yard. Their rank condition was particularly noticeable because the remainder of the grounds were in exceptionally good order, in fact Robinson rather prided himself on the neat appearance of his shop. But the vagrant growth hid a pile of unsightly castings that had lain undisturbed since a certain unlucky day in early spring, and the proprietor of the shop preferred to rest his eyes on the weeds rather than the junk.

There was no reason why these castings should not have been thrown back into the cupola except that Robinson felt he might yet devise a way to make them salable. They represented an initial order, rejected by a very important customer because their surface appearance was unsatisfactory. In vain had Robinson remonstrated that the castings had to be poured under such conditions that a perfectly smooth surface could not be obtained. The customer pointed out that his sales depended on the appearance of his product and remained obdurate. So Robinson, in disgust, threw his castings into the corner of the yard and let the weeds grow up to hide his failure. This was 20 years ago. The castings lay in the yard for many months, until one day Robinson's mail brought him a leaflet describing a new fangled apparatus for cleaning castings by scouring them with a blast of sand mixed with air. He investigated, purchased the machine and turned it loose on the scrap pile in the corner. The result exceeded expectations. A specimen of the cleaned castings was sent to the customer, who had long since forgotten Robinson and his foundry. But by return mail came a yearly contract, at a price considerably higher than Robinson had dared to quote previously. "We have been looking for castings finished like this for years," wrote the customer.

No Foundry Complete Without a Sand-Blast

The foundry industry of the United States has made tremendous strides in the past 20 years and today a sand-blast installation is almost as essential as a melting furnace. Introduced largely on the strength of its ability to impart a superior finish, it has been found that the sand-blast has many other advantages that commend themselves to thoughtful students of cleaning room problems. Unlike pickling, sand-blasting not only produces a superior finish but does the work rapidly. Some castings, with proper apparatus, may be sand-blasted in five minutes, giving a smooth, silky finish which cannot be obtained in any other way.

Machines also have been developed for sand-blasting small castings in quantity with less expenditure of labor than is involved in ordinary tumbling mill operations conducted under the most favorable circumstances. It rarely takes over 25 minutes to thoroughly sand-blast a casting including difficult work such as that illustrated in Figs. 1 and 2. Also, under certain conditions, sand-blasting may be cheaper than other forms of cleaning.

If the castings are to be finished by painting or enameling, the sand-blast furnishes an ideal method of preparing the surface. This method of cleaning also is employed almost exclusively in ornamental iron foundries, such castings being difficult to clean by ordinary methods. The sand-blast not only does the work effectively and quickly, but in addition, preserves all of the delicate outlines and sharp edges of the ornamental casting. In steel foundries the sand-blast has found many applications, particularly in removing the burned sand that clings to steel castings so tenaciously. The sand-blast,

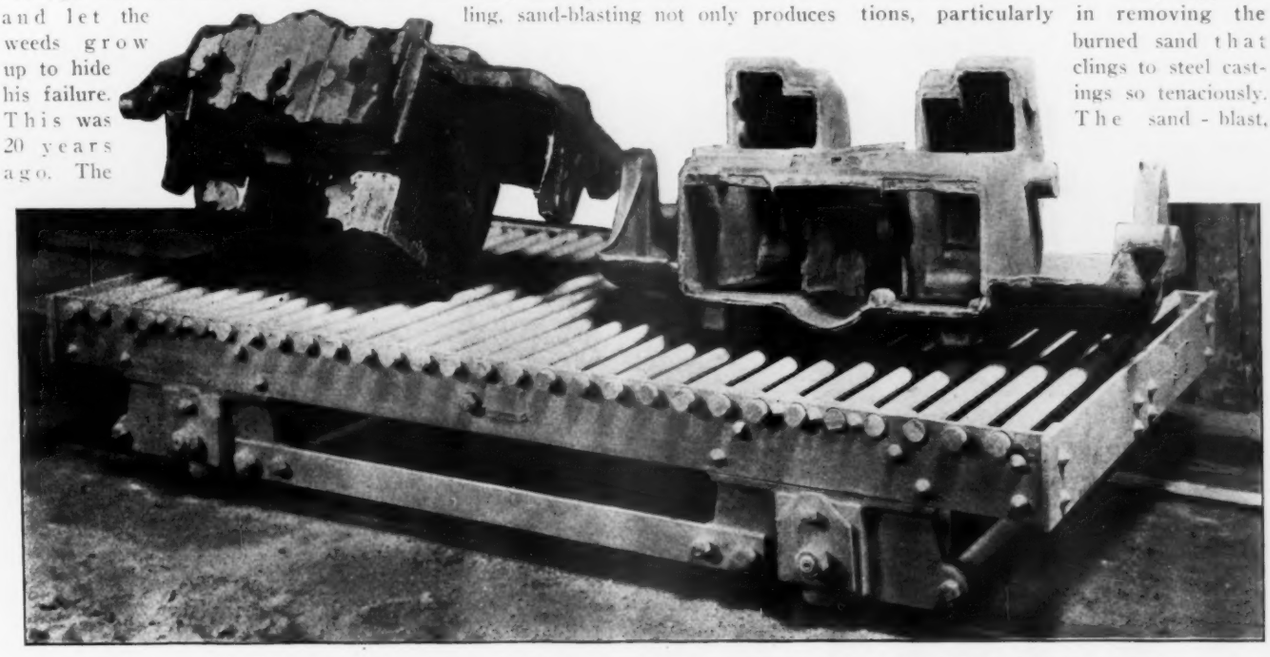


FIG. 1—HEAVY IRREGULARLY SHAPED CASTINGS BEFORE AND AFTER SAND-BLASTING
This illustration also shows a modern type of sand-blasting car. The rods constituting the platform may be easily replaced when they become worn

however, like any other apparatus has its limitations. The cost of a satisfactory installation is considerable. The labor problem is serious, largely because it is customary to employ only the lowest grade of labor for sand-blasting operations. It is doubtful if this practice is to be recommended, since considerable skill is required to obtain the most satisfactory results from any but the purely automatic types of sand-blast machinery. A skillful man, who understands what he is doing, will save the foundryman much more than the amount of his wages. He will not only do the work better but will execute it more rapidly. Also, by paying a little attention to the air consumption of his apparatus, changing nozzles when necessary, a skilled man can easily save a large amount of power.

Until a comparatively recent date, however, it has been difficult to obtain any but the lowest grade of laborers for sand-blasting because of the humanly barbarous conditions under which much of this work has been done in the past. But at present, by installing a proper dust exhaust system and providing the operator with suitable protective devices, it is possible to make the conditions under which the work is done entirely comfortable and healthful. There is absolutely no excuse at this time for the type of sand-blast installation depicted in Fig. 3. This illustration shows what is believed to be the first sand-blast room installed in the United States, in an eastern foundry. This plant, of course, was built before the sand-blast was thoroughly understood, and inadequate provisions were made for handling both the sand and the dust. A single pipe terminating in an inverted funnel in the rear of the room, was relied upon to remove the dust and a belt-driven exhaust fan of small capacity was utilized. This room, which was in continuous use for many years, has been superseded by a thoroughly modern installation in which complete provisions have been made for handling the sand and dust.

The history of the sand-blast extends back 46 years, to 1870, when the first sand-blast patent was issued to B. C. Tilghman. This patent, which contained broad claims, covered the combination of a jet of air and sand for the purpose of cleaning castings. Since that time many forms of sand-blast apparatus have been patented and offered for sale. The early Tilghman machine was sold by Ward & Nash, a firm of machinery dealers who had headquarters in Boston.

As in the introduction of other great inventions, it was necessary to fight prejudice and the progress of the sand-blast during the first 25 years following its inception was exceedingly slow. As late as 1894 the author of a paper on stove foundry cleaning rooms, read before the National Association of Stove Manufacturers, stated that it was not necessary for him to describe the sand-blasting process, "as this method has been tried and found wanting." In spite of opposition, however, the sand-blast continued to make progress and by 1896 various forms of sand-blasting apparatus were extensively advertised in the foundry and iron trade papers. The sand-blast found early favor in Europe, particularly in Germany. The Germans and Swiss were especially progressive in developing automatic types of sand-blasting apparatus, and in 1897 rotary-table semi-automatic sand-blast machines of advanced design were extensively employed in the foundry of Sulzer Bros., at Winterthur, Switzerland, and in other prominent plants in central Europe. The machine in the Sulzer Bros. plant was described as follows in *The Foundry* in September, 1897:

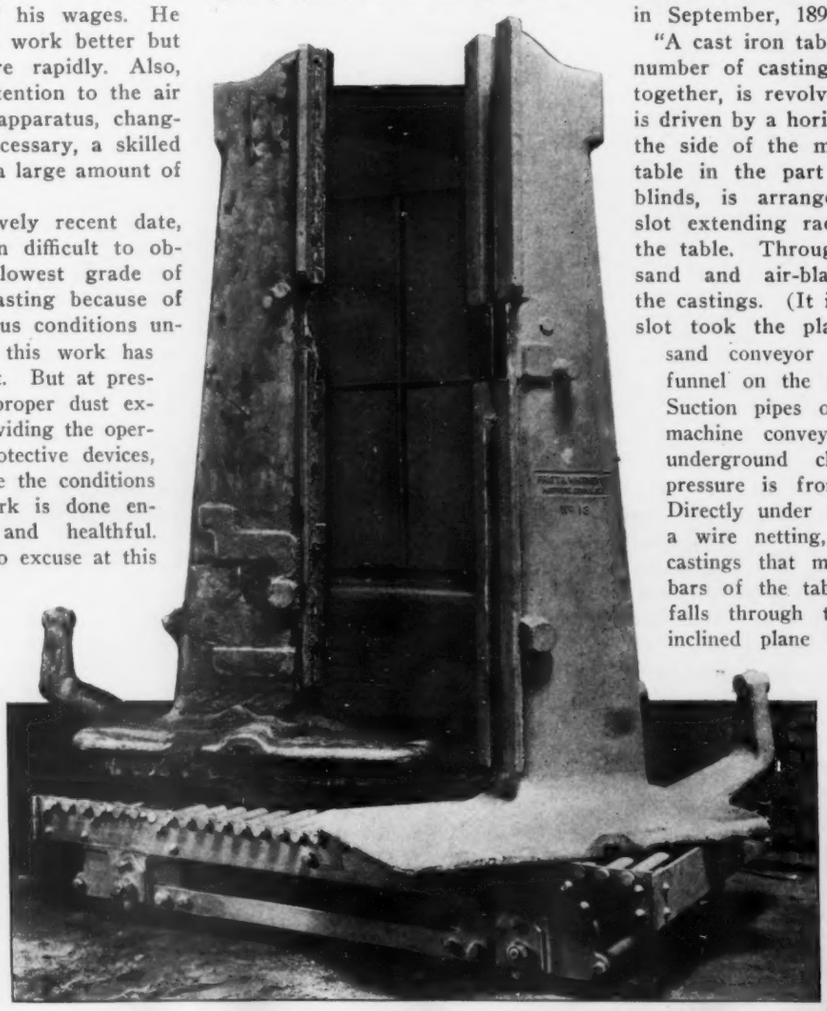


FIG. 2—GRAY IRON MACHINE TOOL CASTINGS BEFORE AND AFTER SAND-BLASTING

"A cast iron table on which a large number of castings can be put close together, is revolved all the time and is driven by a horizontal shaft fixed to the side of the machine. Above the table in the part behind the rubber blinds, is arranged a long narrow slot extending radially over one-half the table. Through this opening the sand and air-blast together strike the castings. (It is apparent that this slot took the place of nozzles.) A sand conveyor continuously fills a funnel on the top of the machine. Suction pipes on each side of the machine convey the dust into an underground channel. The blast pressure is from 11 to 12 ounces. Directly under the table is attached a wire netting, catching any small castings that may fall between the bars of the table. The sand itself falls through the netting onto an inclined plane that brings it back again to the conveyor. One or generally two passages under the sand-blast are enough to clean the castings on one side whereupon they are turned over and go back through the machine again." During the decade between 1900 and 1910 the Germans made such progress in the perfection of sand-blasting apparatus that, although it is an American invention, it was necessary, until three or four years ago, for foundrymen in this country to look abroad for the latest developments. Fortunately this situation has been remedied and recently sand-blasting has come into its own in this country. The leadership in the art has again been transferred to the western side of the Atlantic.

A complete modern sand-blasting installation includes not only the sand-blast machine itself but means for

DECIMAL EQUIVALENTS.

By S. L. Cook

DECIMAL EQUIVALENTS FOR 64ths

1/64	.01563	17/64	.26563	33/64	.51563	49/64	.76563
1/32	.03125	9/32	.28125	17/32	.53125	25/32	.78125
3/64	.04688	19/64	.29688	35/64	.54688	51/64	.79688
1/16	.0625	5/16	.3125	9/16	.5625	13/16	.8125
5/64	.07813	21/64	.32813	37/64	.57813	53/64	.82813
3/32	.09375	11/32	.34375	19/32	.59375	27/32	.84375
7/64	.10938	23/64	.35938	39/64	.60938	55/64	.85938
1/8	.125	3/8	.375	5/8	.625	7/8	.875
9/64	.14063	25/64	.39063	41/64	.64063	57/64	.89063
5/32	.15625	13/32	.40625	21/32	.65625	29/32	.90625
11/64	.17188	27/64	.42188	43/64	.67188	59/64	.92188
3/16	.1875	7/16	.4375	11/16	.6875	15/16	.9375
13/64	.20313	29/64	.45313	45/64	.70313	61/64	.95313
7/32	.21875	15/32	.46875	23/32	.71875	31/32	.96875
15/64	.23438	31/64	.48438	47/64	.73438	63/64	.98438
1/4	.25	1/2	.5	3/4	.75	1	1.00000

(Continued on Data Sheet No. 218.)

DECIMAL EQUIVALENTS.

By S. L. Cook

(Continued from Data Sheet No. 217.)

EQUIVALENTS TO 3rds, 6ths, 12ths AND 24ths IN 64ths

1/24	.04167	1/64	9/24	.375	3/8	17/24	.70833	45/64
1/12	.08333	5/64	5/12	.41667	27/64	9/12	.75	3/4
3/24	.125	1/8	11/24	.45833	29/64	19/24	.79167	51/64
1/6	.16667	11/64	3/6	.5	1/2	5/6	.83333	53/64
5/24	.20833	13/64	13/24	.54167	35/64	21/24	.875	7/8
3/12	.25	1/4	7/12	.58333	37/64	11/12	.91667	59/64
7/24	.29167	15/64	15/24	.625	5/8	23/24	.95833	61/64
1/3	.33333	21/64	2/3	.66667	43/64	.....	.....	..

EQUIVALENTS TO 7ths, 14ths AND 28ths IN 64ths

1/28	.03571	1/32	5/14	.35714	23/64	19/28	.67857	43/64
1/14	.07143	1/16	11/28	.39286	25/64	5/7	.71429	23/32
3/28	.10714	3/32	3/7	.42857	27/64	21/28	.75	3/4
1/7	.14286	1/8	13/28	.46429	29/64	11/14	.78571	25/32
5/28	.17857	11/64	7/14	.5	1/2	23/28	.82143	27/32
3/14	.21429	7/32	15/28	.53571	17/32	6/7	.85714	55/64
7/28	.25	1/4	4/7	.57143	37/64	25/28	.89286	57/64
2/7	.28571	9/32	17/28	.60714	39/64	13/14	.92857	59/64
9/28	.32143	5/32	9/14	.64287	41/64	27/28	.96429	31/32

THE FOUNDRY DATA SHEET, SEPTEMBER, 1916

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

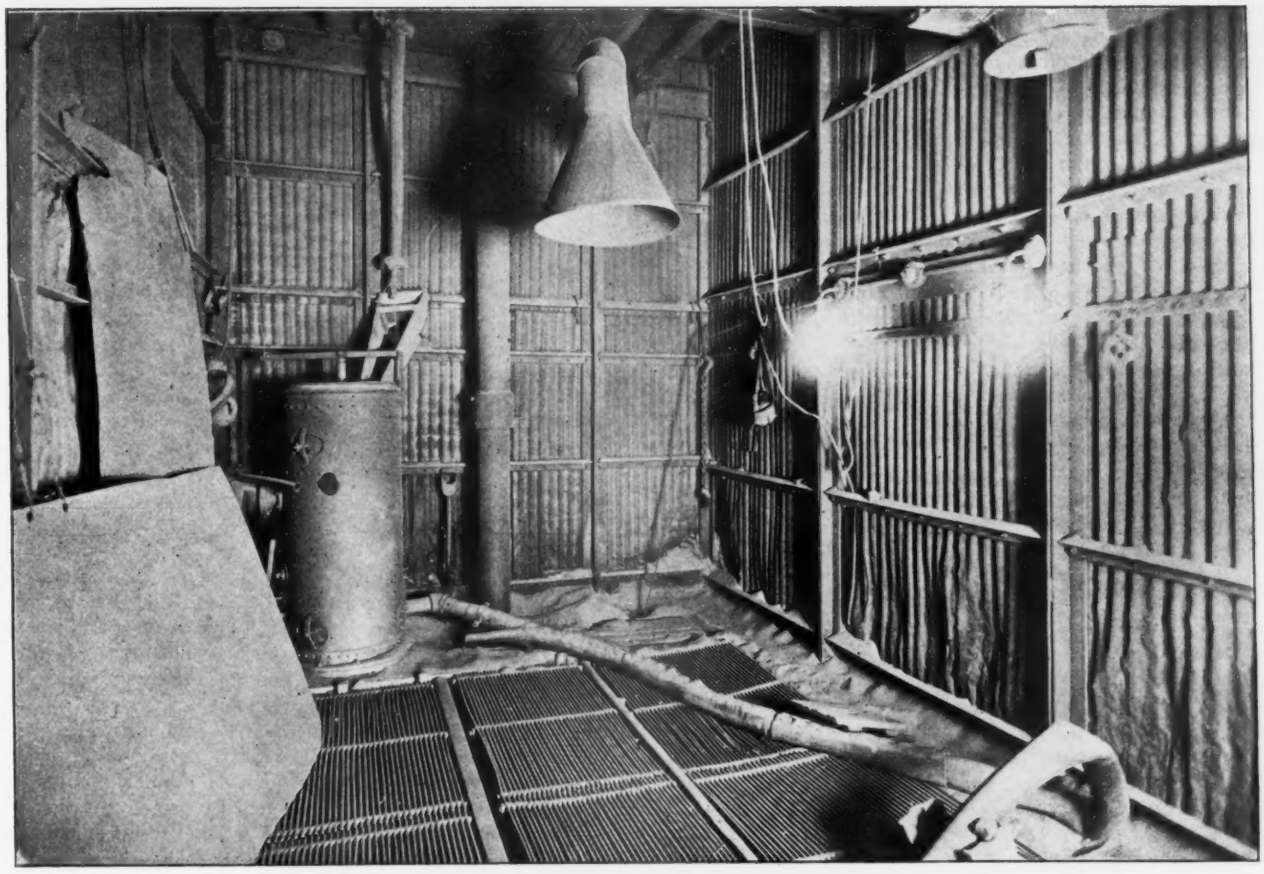


FIG. 3—THE FIRST SAND-BLAST ROOM INSTALLED IN THE UNITED STATES

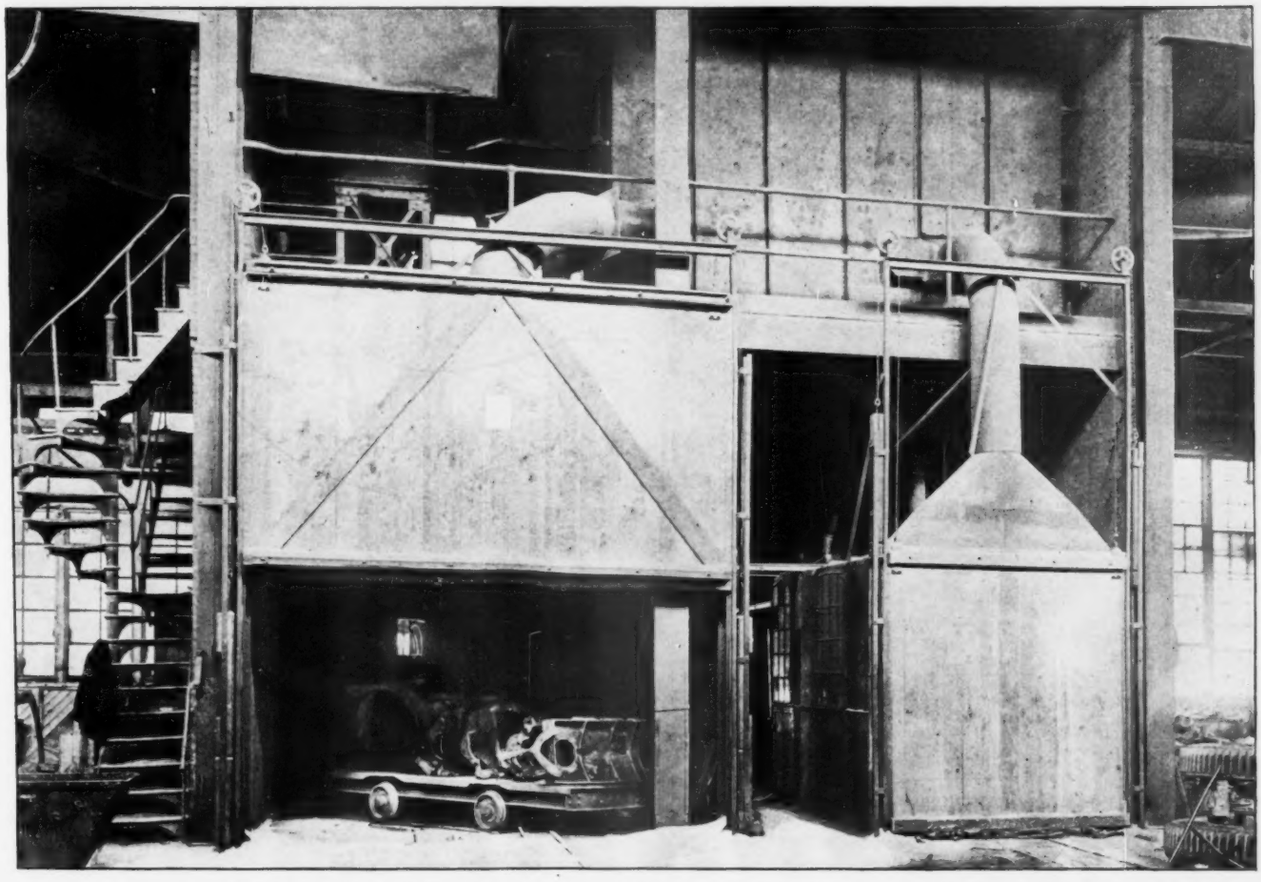


FIG. 4—A MODERN SAND-BLAST ROOM EQUIPPED WITH SPECIAL DUST EXHAUST APPARATUS

handling the dust, screening and treating the sand, and providing the necessary compressed air. The tendency is toward the development of self-contained apparatus, which embodies all of these functions. There are two general types of sand-blasting machines in use at the present time, namely the gravity type and the pressure type. In the former, the sand is propelled by a jet of air striking it as it trickles down from an overhead sand tank. In the latter type of machine the sand tank is closed and under pressure. This permits of the use of much higher pressures, which are necessary for sand-blasting steel castings. The four principal types of apparatus that have been developed for utilizing the sand-blast effectively in foundries in this country include sand-blast rooms, sand-blast tumbling barrels, rotary-table sand-blast machines, and sand-blast cabinets. Each form of apparatus has its particular field of application. Among the principal manufacturers of sand-blast equipment in the United States today are the American Foundry Equipment Co., Cleveland; J. M. Betton, New York; Brown Specialty Machinery Co., Chicago; Curtis Pneumatic Machinery Co., St. Louis; Gardner Governor Co., Quincy, Ill.; Hoevel Mfg. Corporation, New York; Mott Sand-Blast Mfg. Co., Chicago; New Haven Sand-Blast Co., New Haven, Conn.; Pangborn Corporation, Hagerstown, Md.; J. W. Paxson Co., Philadelphia; Elmer E. Perkins, Chicago; W. W. Sly Mfg. Co., Cleveland; Tilghman-Brooksbank Sand-Blast Co., Philadelphia, and the Whiting Foundry Equipment Co., Harvey, Ill.

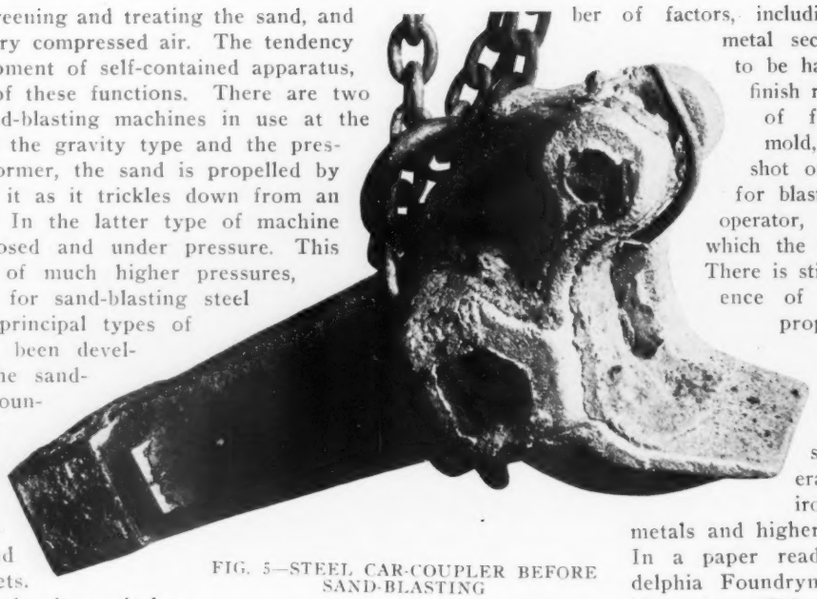


FIG. 5—STEEL CAR-COUPLER BEFORE SAND-BLASTING

Although the sand-blast has been developed to a high state of perfection, some of the engineering problems involved have not yet been fully standardized. This is due, to a large extent, to the inherent difficulties involved in the problem. It is not possible, for instance, to rate the capacity of a sand-blast machine accurately owing to the great variety of work which it is called upon to handle. Therefore, the proper equipment for a given installation is a matter of judgment, based on experience. The selection of apparatus is influenced by a large number of factors, including the weight and metal section of the castings to be handled, the degree of finish required, the character of facings used in the mold, the kind of sand, shot or crushed steel used for blasting, the skill of the operator, the temperature at which the metal is poured, etc. There is still considerable difference of opinion as to the proper pressures which should be used for sand-blasting work, although the consensus of opinion seems to favor moderate pressures for gray iron and non-ferrous metals and higher pressures for steel. In a paper read before the Philadelphia Foundrymen's Association in November, 1902, A. G. Warren recommended 10 pounds per square inch for sand-blasting brass castings, 15 to 20 pounds for gray iron, and 25 to 30 pounds for steel. Later developments have demonstrated that somewhat higher pressures are necessary particularly for steel castings which frequently are coated with a very hard skin of burned sand. One modern authority recommends 20 pounds per square inch for brass and aluminum castings, 20 to 40 pounds for gray iron work and 80 pounds for steel castings. These pressures appear to be those most generally employed at the present time. It is advisable to use as low a pres-

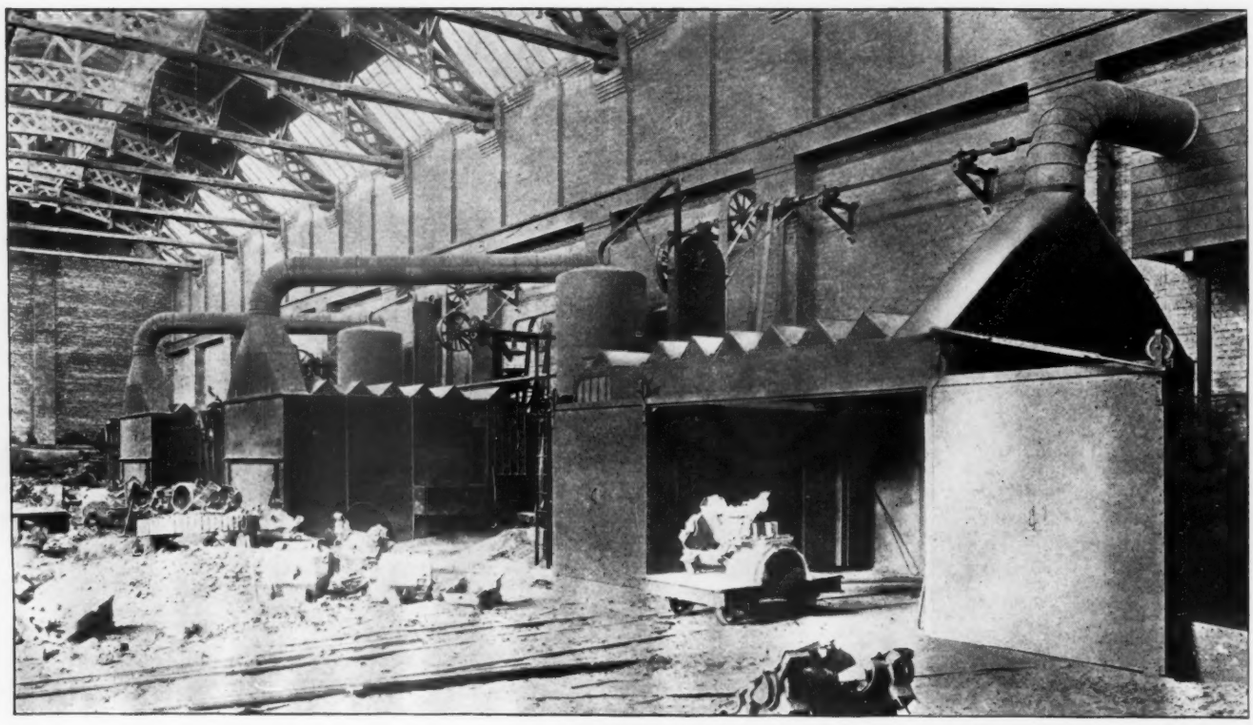


FIG. 6—A GERMAN SAND-BLAST ROOM INSTALLATION

sure as possible, compatible with satisfactory and rapid work, in order to reduce the power consumption. Take, for example, a sand-blast for cleaning gray iron castings, using 20 pounds pressure through a ½-inch nozzle. The amount of free air required per minute would be about 120 cubic feet. To compress this air to 20 pounds requires about nine-horsepower. To compress the same quantity to 80 pounds would require 23 horsepower. Of course, if a low pressure machine is used in a foundry where the air is compressed to 80 pounds per square inch for pneumatic tools and other purposes, a reducing valve may be employed, but in this case the excess horsepower required to compress the air to the higher pressure is lost. In the example just cited this loss amounts to 14-horsepower, and in a year it would nearly pay for a special air compressor for the sand-blast apparatus. Owing to the fact that practically every modern foundry is supplied with electric power, there is a decided tendency to equip sand-blast apparatus operating at less than 80 pounds per square inch with special motor-driven compressors. This prevents loss of power and avoids taking air for the sand-blast from the main foundry air lines. It also tends to make the sand-blast apparatus self-contained. When the air-compressor is located at a distance from the sand-blast machine it is necessary to take account of the drop in pressure due to friction in the pipes, in order to insure a satisfactory working pressure at the machine. If a small pipe with a large number of elbows is used, the drop in pressure may be very considerable. The standard engineering handbooks contain complete data dealing with this subject. When the pipe lines are long, traps or other arrangements should be provided to separate the moisture from the air. Excessive amounts of oil in the air also are bad and engineers operating compressors furnishing air for sand-blast apparatus should be cautioned against too liberal lubrication of the air cylinders of the compressors. The oil is carried along by the air in the form of globules, which may clog the apparatus on striking the sand. The design of the sand-blast nozzle has an important influence on the air consumption. Up-to-date machines are provided with nozzles which are theoretically correct for the work they are called upon to perform. Inasmuch, however, as no material has as yet been discovered which will resist the abrasive action of the sand, all nozzles wear rapidly and if this is allowed to proceed too far, the increase in air consumption may become very serious. Engineering hand-books contain tables, showing the cubic feet of free air per minute flowing through different sizes of nozzles at various pressures, together with the horsepower developed in single stage compression. Reference to these tables indicates, for instance, that whereas a ½-inch nozzle operating under 30 pounds pressure consumes 161 cubic feet of free air per minute, requiring about 16½-horsepower for its development, the air consumption will be increased to 252 cubic feet, requiring 26-horsepower, if the nozzle is permitted to wear to ⅝-inch diameter. Nozzles are cheap and should be changed frequently.

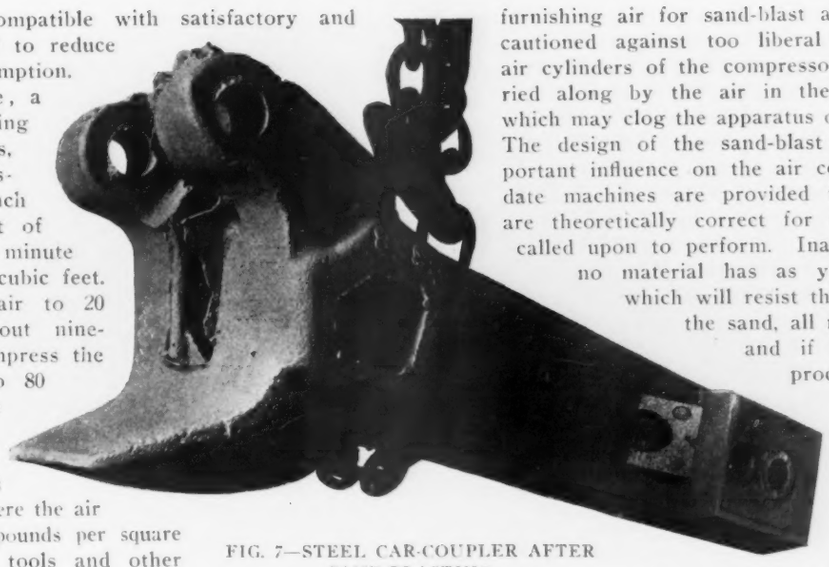


FIG. 7—STEEL CAR-COUPLER AFTER SAND-BLASTING

In 1910 a series of tests on the efficiency of sand-blasting were made

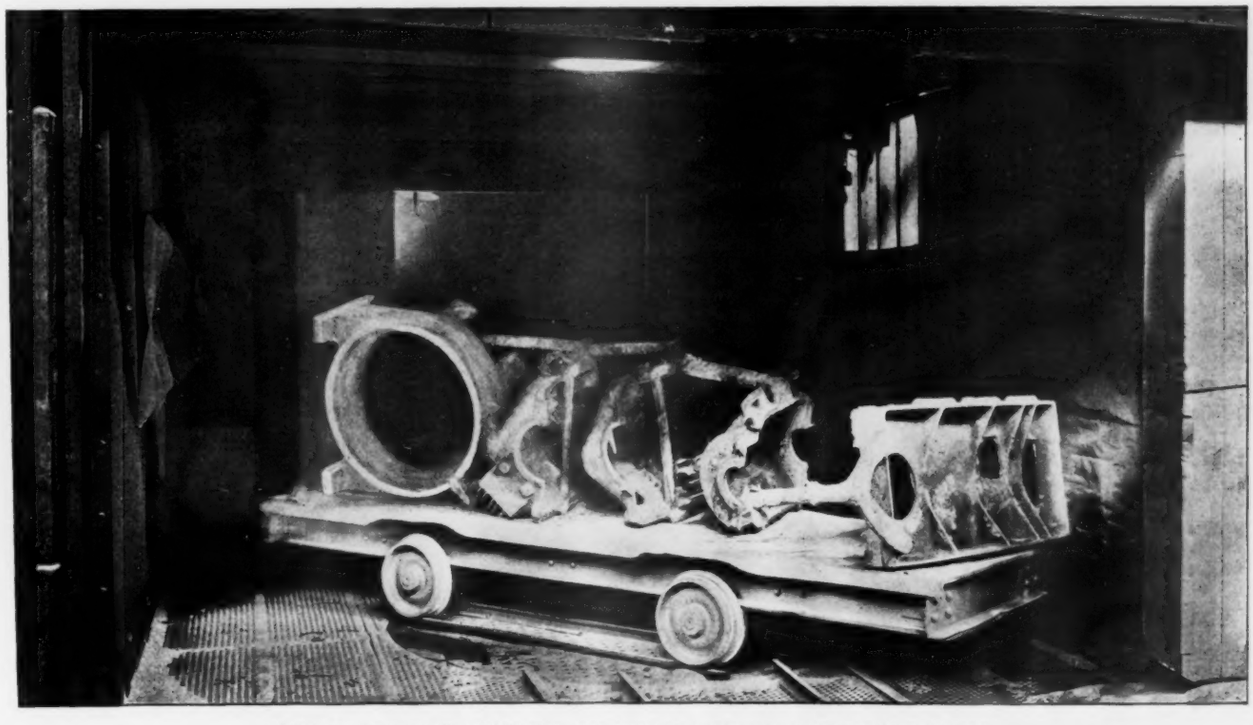


FIG. 8—LOAD OF CASTINGS ON TURNTABLE IN SAND-BLAST ROOM

FIG. 9—STEEL PLATE SAND-BLAST ROOM

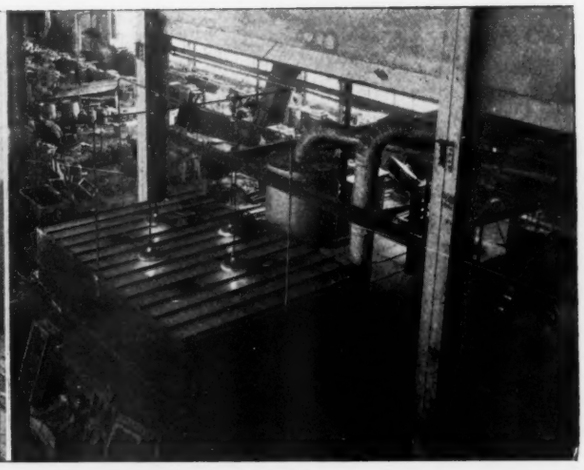


FIG. 10—SAND-BLAST ROOM WITH GLASS ROOF

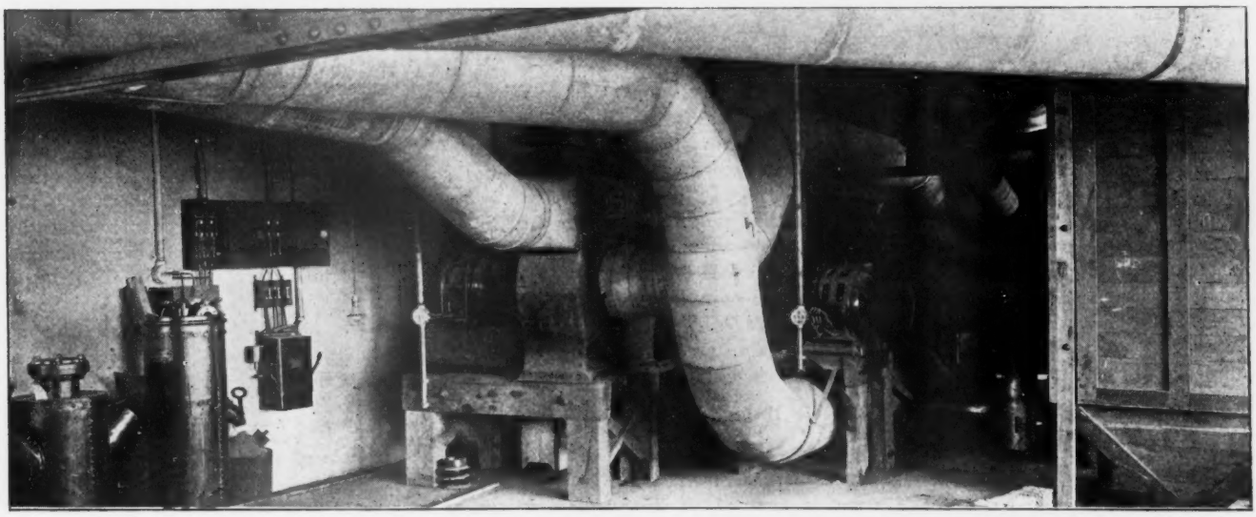


FIG. 11—MOTOR-DRIVEN DUST EXHAUST APPARATUS FOR A MODERN SAND-BLAST ROOM INSTALLATION

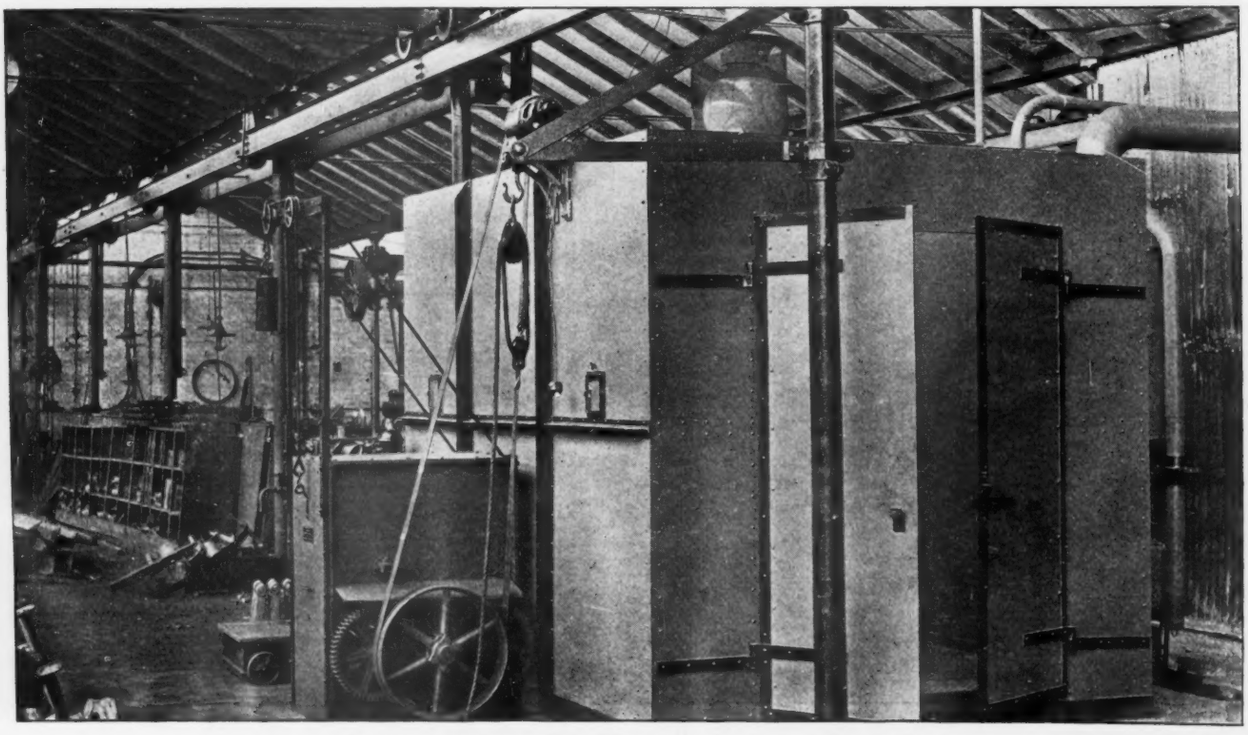


FIG. 12—AN ENGLISH SAND-BLAST ROOM INSTALLATION

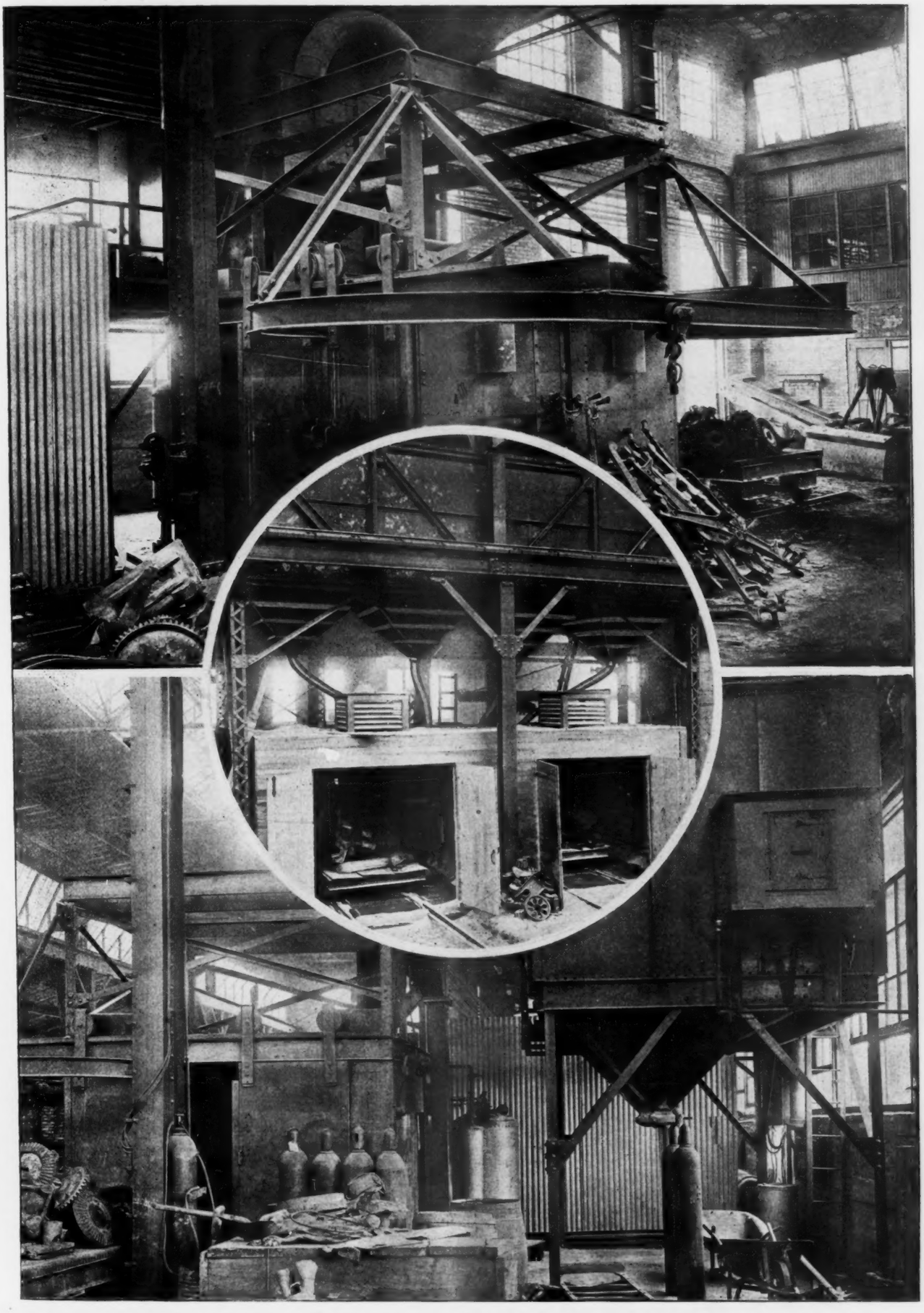


FIG. 13—SAND-BLAST ROOM EQUIPPED WITH I-BEAM TROLLEY FOR HANDLING CASTINGS
FIG. 14—SAND-BLAST ROOMS PROVIDED WITH SPECIAL OVERHEAD SAND BINS
FIG. 15—DOUBLE-ENDED SAND-BLAST ROOM—DUST COLLECTING SYSTEM IS SHOWN AT THE RIGHT

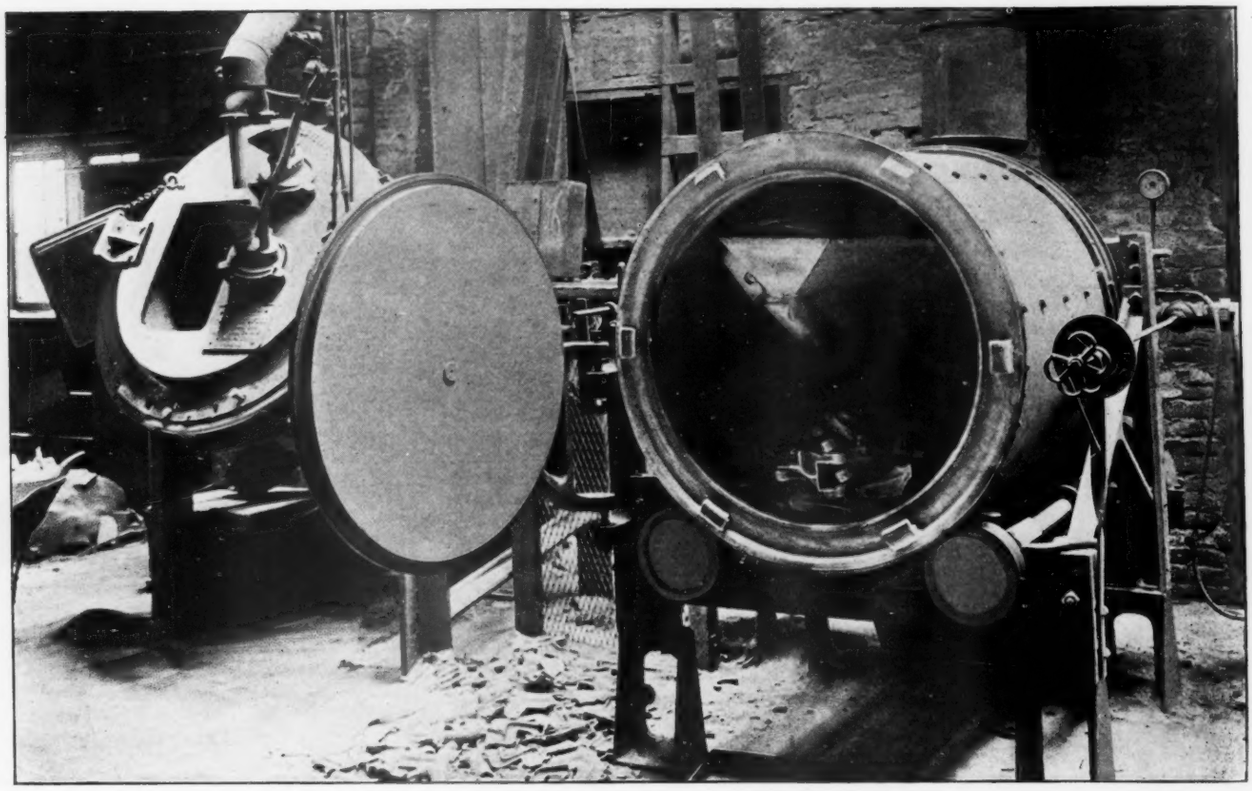


FIG. 16—AUTOMATIC SAND-BLAST BARRELS INSTALLED IN A MALLEABLE FOUNDRY

at the Ohio State University by David H. Ebinger and Robert A. Frevert, under the direction of Prof. W. T. Magruder. In the conclusions formulated from these tests, as given in a paper presented before the American Society of Mechanical Engineers in 1912, it is stated that, "For a constant distance of 8 inches, and at a constant angle of 45 degrees, between the nozzle and the test bar (being sand-blasted), the equivalent amount of free air delivered per minute, the iron removed, the sand discharged, and the sand used up per 100 cubic feet of free air flowing per minute vary directly with the pressure. The per cent of usable sand remaining and the amount of sand discharged per pound of iron removed vary inversely with the air pressure in

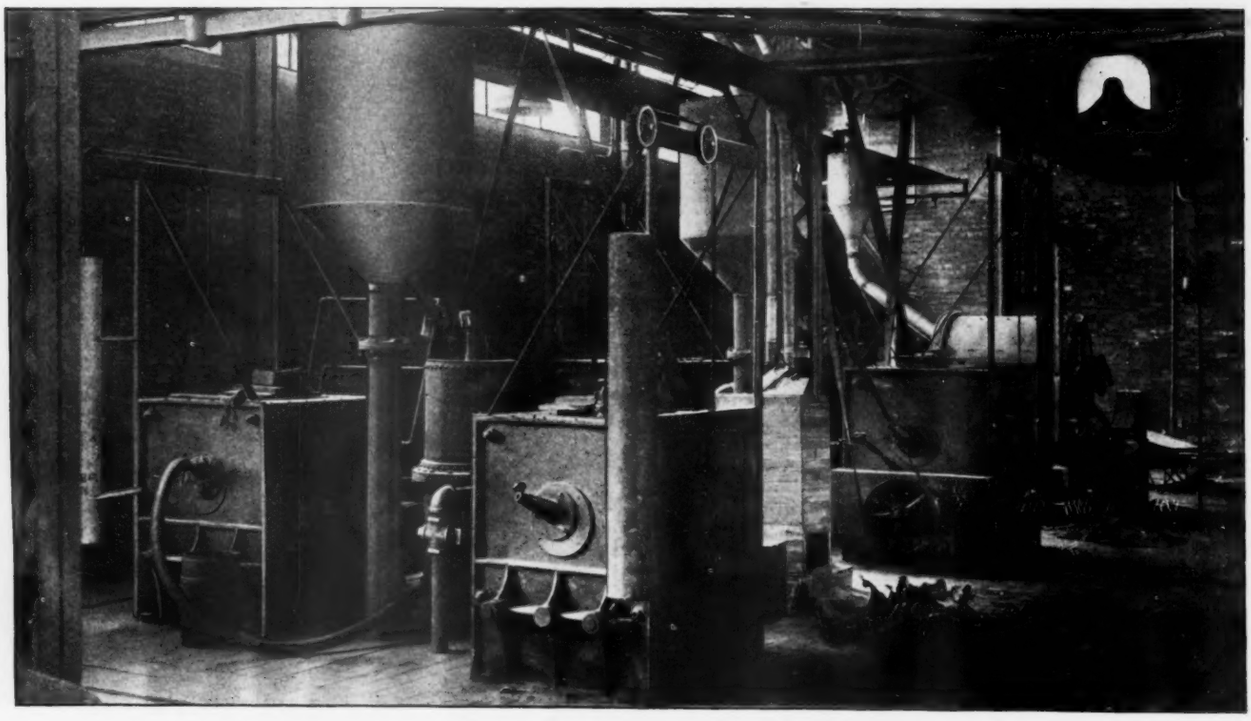


FIG. 17—A WELL ARRANGED AUTOMATIC SAND-BLAST BARREL DEPARTMENT

the machine." It was also found that with a constant pressure of 60 pounds in the machine and a fixed distance of 8 inches from the nozzle to the work, the largest amount of metal was removed, and the least amount of sand was required to do it, when the angle between the work and the nozzle was 40 to 60 degrees.

The fact that the efficiency of the process varies directly with the amount of usable sand remaining in the machine makes it necessary to provide apparatus for separating the dust or shattered sand from the good sand before the material is run through the nozzle a second time. A means of properly effecting this separation is provided with every modern sand-blast installation. Some of the difficulty resulting from shattering the sand can be obviated by utilizing as moderate pressures as possible. The higher the air pressure the faster the sand is destroyed. With modern, high-pressure apparatus operating on steel castings, it is essential to employ sand, shot or crushed steel that will offer maximum resistance to the impact against the casting.

Owing to the wide variety of the work handled it is difficult to obtain standardized data on the cost of sand-blasting. Some figures covering individual cases, however, may be interesting. A series of tests recently were conducted at the Case School of Applied Science, Cleveland, to show the relative costs of cleaning a 6-cylinder automobile casting by plain rumbling and by sand-blasting. The tests were made in a prominent Cleveland foundry and a sand-blast machine built by the American Foundry Equipment Co., New York, was used. For sand-blasting 71 castings the cost is given as follows:

Labor	$3.301
Air	0.728
Fixed charges	0.530
Total	$4.559

For rumbling 84 castings in a common tumbling mill the costs are given as follows:

Labor	$5.49
Power	1.37
Fixed charges	1.53
Total	$8.39

The cost of the sand-blasted work was 6.4 cents per casting, and the cost of the rumbled work was 10 cents per casting.

Manganese-steel castings are exceedingly tough, dense and hard. They cannot be machined by ordinary methods and grinding wheels are used. As an indication of the capacity of modern sand-blasting apparatus, the following figures covering miscellaneous steel castings cleaned with a closed-hopper sand-blast machine manufactured by the Curtis Pneumatic Machinery Co., St. Louis, are interesting. According to these figures, an average day's work of nine hours would be 14 tons of miscellaneous manganese-steel castings ranging from 75 to 500 pounds each; on ordinary steel castings, greater tonnage could be cleaned. The figures are as follows:

Name of piece.	Weight of casting, pounds.	Time required to sand-blast one casting, hours.
Kominuter plate	214	0.05
Screen plate	87	0.08
Plate for hammer mill	260	0.05
Curved segment	72	0.05
Roller	101	0.05
Frog insert	308	0.05
Frog	105	0.05
Racks	484	0.08
Frog insert	189	0.08
Pinion	97	0.08
Gear	420	0.08
Gear	206	0.08
Gear	215	0.08
Sheave	97	0.05
Totals	2,855	0.91

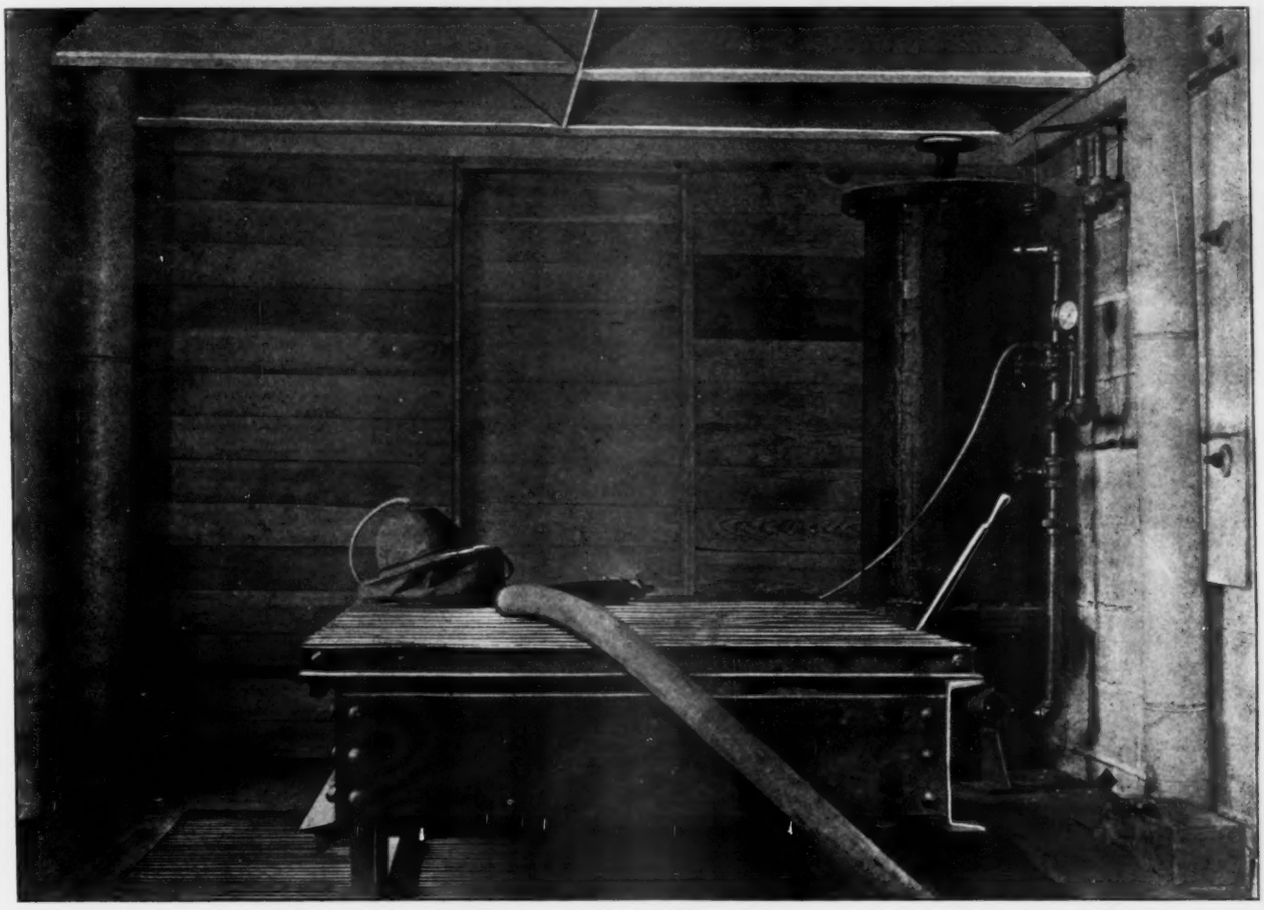


FIG. 18—A SAND-BLAST ROOM PROVIDED WITH SPECIAL DUST EXHAUST HOODS IN THE CEILING

The subject of dust-control has occupied a large share of the atten-

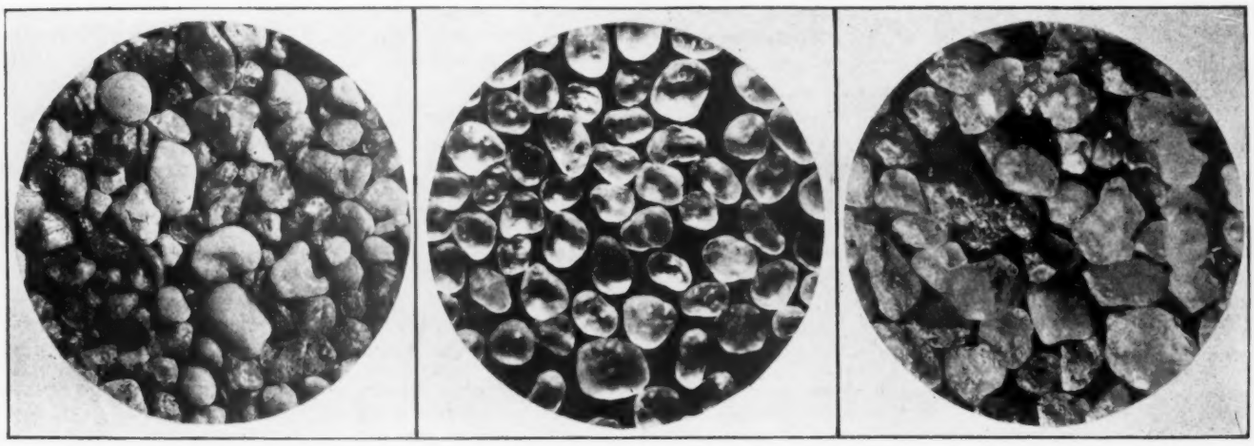


FIG. 19—OCEAN SAND-BLAST SAND

FIG. 20—ILLINOIS SAND-BLAST SAND

FIG. 21—OHIO SAND-BLAST SAND

tion of sand-blast designers and engineers during the past few years. Sand-blasting is of necessity a dusty operation, and to the fact that early designers did not give this feature sufficient attention was due, as much as anything else, the slow progress made by the sand-blast in the years immediately following its invention. Until comparatively recently so-called open air sand-blasting was attempted, invariably, however, with indifferent success. It is perfectly feasible to control the dust so that it will not be in the least troublesome. If the work is of such a nature that it can be handled in a sand-blast barrel or in a rotary-table or cabinet type machine, there is no dust discharged into the room. These machines are fitted with exhaust fans which remove the dust and discharge it into some suitable form of collector.

Three forms of dust collectors are employed in connection with sand-blast apparatus, including the centrifugal, the dry screen and the wet types. In the centrifugal type, the dust is exhausted into a large container in which it is given a swirling motion. The heavier particles are thrown to the outside where they are caught by baffles and conducted to the bottom of the receiver. In the dry-screen type of dust collector, illustrated in Fig. 15, the air is carried through a series of fine screens on which the dust gathers. Usually a mechanism is provided for rapping the screens in order to knock off the dust, permitting it to fall into collection hoppers at the bottom. The screens also are removed periodically and thoroughly cleaned. This is the type of dust-collector usually employed in connection with American sand-blast installations. In the wet type of dust-collector, or scrubber, the air is forced to pass through fine sprays of water which wet the dust particles, causing them to coalesce until they become sufficiently heavy to fall to the bottom of the apparatus from which the sludge is removed at intervals. Unless proper dust-removal apparatus is provided, the workmen in sand-blast rooms are in constant danger of contracting tuberculosis. One modern authority states that seven changes of air per minute are neces-

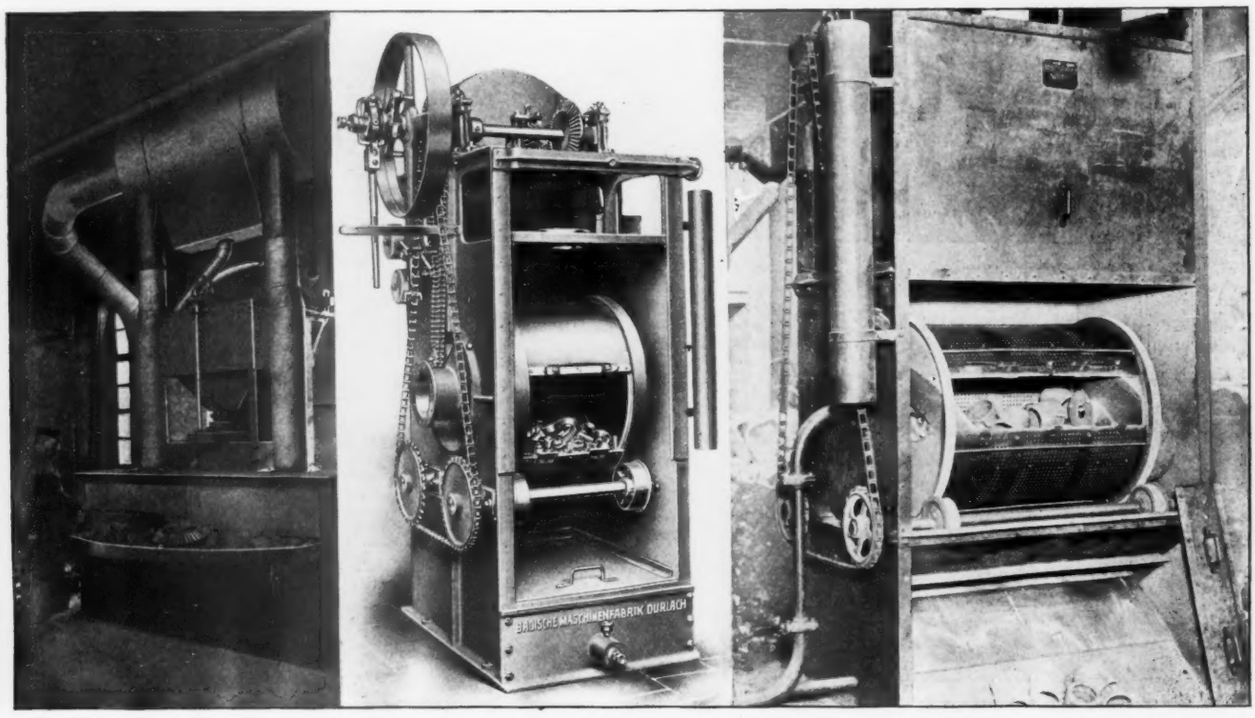
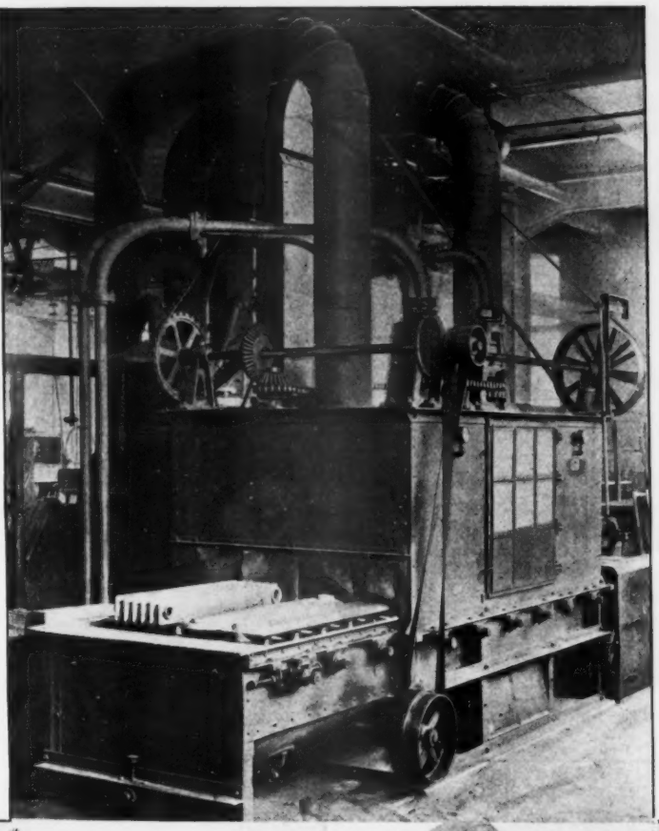


FIG. 22 — GERMAN TABLE MACHINE WITH UNIQUE DUST-EXHAUST ARRANGEMENTS

FIG. 23—A MODERN GERMAN SAND-BLAST BARREL OF THE SELF-CONTAINED TYPE

FIG. 24—AMERICAN AUTOMATIC SAND-BLAST BARREL

sary to insure proper living conditions in a sand-blast room. It is also stated that in many installations not more than two changes are provided. There is a strong tendency among designers to greatly increase the volume of air passing through the sand-blast room. In many states, laws have been passed, compelling the abatement of the dust nuisance, but progressive foundrymen do not need legal enactments to force them to provide satisfactory working conditions. It is as much to the proprietor's advantage as it is to that of the employe that sand-blasting be conducted under suitable conditions. Satisfactory work cannot be expected in a room where the dust is so thick a man cannot see his hand before his face. Sand-blast helmets, also, are now provided, which practically exclude dust even though the operator is compelled to work under otherwise unfavorable conditions. Respirators also may be used. As an illustration of the progress which has been made in the effective control of dust, contrast the conditions illustrated in Fig. 3 with those shown in Fig. 4. As previously mentioned, Fig. 3 shows the first sand-blast room installed in the United States. Fig. 4 shows a recent installation furnished the National Steel Foundries, Milwaukee, by the Hoevel Mfg. Corporation, New York. In the Hoevel sand-blast room, the floor, ceiling and two sides of the chamber are provided with slots through which the exhaust fan sucks the air. The slots are so arranged that an air veil is formed which, it is said, cannot be penetrated by the dust. This veil divides the chamber into two parts. The dust developed underneath the air veil is sucked away from the room as soon as it arises, so that the workman, who stands above the dust zone, is not molested in any way.



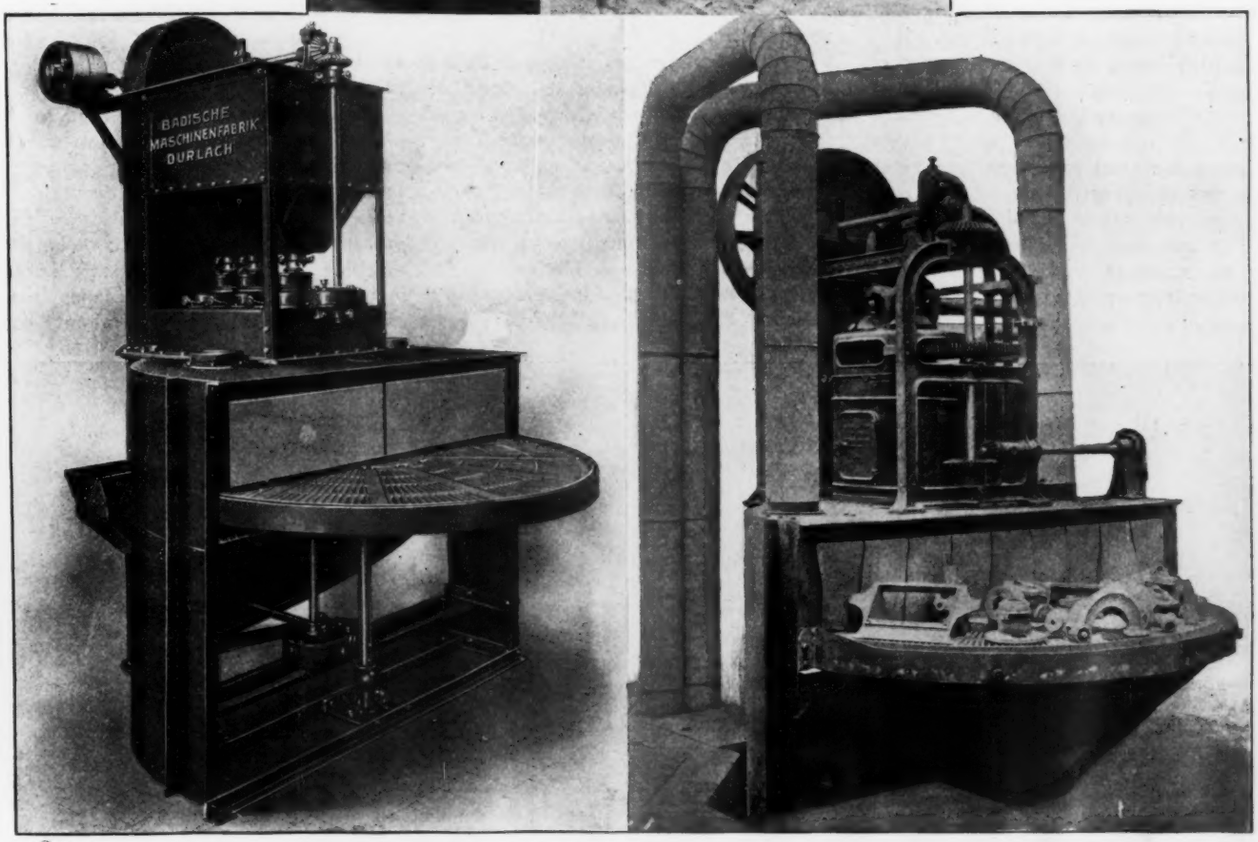


FIG. 25—CABINET TYPE SAND-BLAST MACHINE FOR TREATING RADIATOR COLUMNS
FIG. 26—GERMAN ROTARY-TABLE SAND-BLAST MACHINE OF MODERN DESIGN
FIG. 27—AMERICAN ROTARY-TABLE SAND BLAST MACHINE DEVELOPED FROM THE GERMAN MACHINE SHOWN IN FIG. 26

A modern sand-blast room installed by the Tilghman-Brooksbank Sand-Blast Co., Philadelphia, at the plant of the Taylor & Boggis Foundry Co., Cleveland, is illustrated in Figs. 9 and 10. Fig. 11 also shows the dust-exhaust fans in this plant. The fans are direct-connected to electric motors. This room is of steel plate construction. It will be noted from Fig. 9 that an extension from the industrial track serving the molding floor passes through the center of the room, which is provided with double doors at either end. The castings are delivered to the room on flat cars and after being sand-blasted, they are conveyed to the cleaning room for subsequent chipping operations. The floor is perforated and the sand falls into a hopper from which it is removed periodically. After the used sand is cleaned and the dust particles separated out, it is again delivered to the sand-blast room for further use. It will be noted that the grating covers the entire floor of the room so there is no chance for sand to accumulate in the corners or along the sides. The lighting of this room is unique, the light being admitted through the roof which is glass, as shown in Fig. 10. Four electric lamps are suspended above the room so as to reflect their rays directly onto the work being sand-blasted.

Figs. 4 and 8 show detailed views of the sand-blast installation at the plant of the National Steel Foundries, Milwaukee, previously mentioned. The equipment at this plant includes two sand-blast chambers, the largest of which is 18½ feet in length, 14 feet in width and 8½ feet high. The smaller chamber is 8 feet 2 inches wide, 12 feet 8 inches long and 8 feet 6 inches high. The grated floor of the larger chamber is fitted with a turntable which is designed to carry a weight of 30 tons, and as the work proceeds the turntable is rotated slowly. This enables the operator to sand-blast the castings on all sides without changing his position. The movement of the turntable is controlled by a lever inside the sand-blast room.

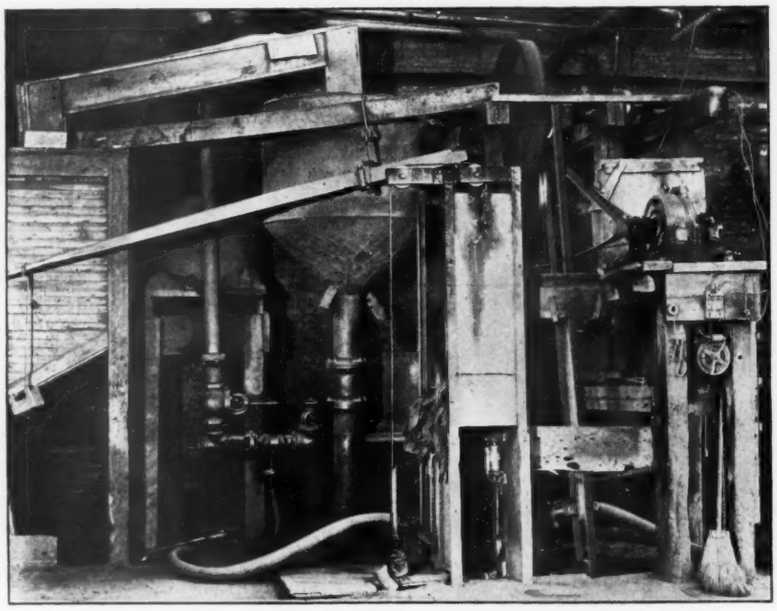


FIG. 28—SPECIAL CABINET FOR SAND-BLASTING CAR WHEELS

The used sand falls through the floor grating into two hoppers from which it passes through two sieves and then into troughs leading to screw conveyors. The latter carry the sand to a point under the rear of the sand-blast room where it is discharged into the boot of a bucket elevator. This elevator delivers the sand to a separator from which it is discharged into a hopper over the tank of the sand-blast machine. The sand is held back by a valve, which opens automatically when the air pressure is applied to the nozzle. At the two rear corners of the room there are vertical openings to admit fresh air from the outside, and there is also a horizontal slot at the top of the back wall which provides further ventilation. The opening for the exhaust is in the ceiling at the front of the room. The fan exhausts 12,250 cubic feet of air per minute, thus changing the air in the room about 5½ times per minute.

The high-pressure air for the sand-blast machine is delivered from an air main carrying 90 pounds per square inch. It is discharged through a reducing valve which cuts down the pressure to 65 pounds for use in the machine. The sand-blast tank is 41 inches in diameter by 79 inches high and has a capacity of about 460

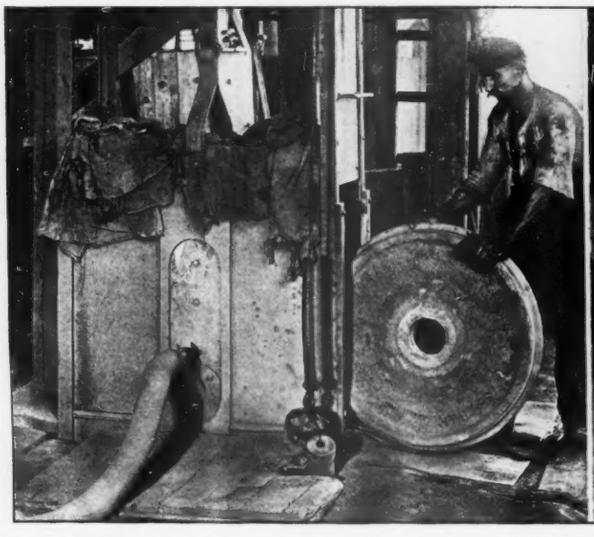


FIG. 29—ANOTHER VIEW OF CAR WHEEL SAND-BLASTING APPARATUS

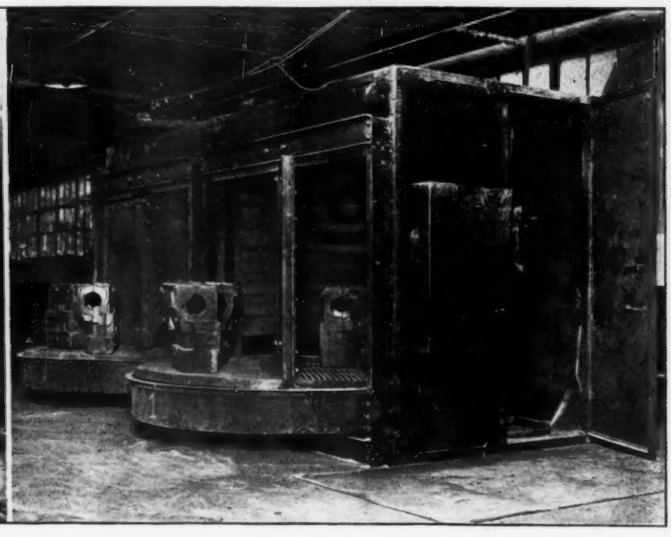


FIG. 30—INTERESTING SAND-BLAST ROOM WITH REVOLVING TABLE

pounds. A ⅝-inch nozzle is used. The two sand-blast rooms at this plant handle about 45 tons of castings a day and this tonnage probably could be increased if there was some arrangement whereby two trucks could be used for each sand-blast room. At present, time is lost while each truck is being loaded and unloaded.

Figs. 13 and 15 show two views of the sand-blast room installed at the plant of the Sivyer Steel Casting Co., Milwaukee. This installation differs from the one in use at the National Steel Foundries in that the cars of castings are not revolved while being blasted. Instead, the sand-blast room is provided with doors at either end making possible the use of two cars. The tracks are so arranged that the room may be used continuously, one car being unloaded and loaded while the other is in the sand-blast room. Another feature of this installation is the circular monorail which is clearly shown in Fig. 13. The heavier castings are suspended on this monorail and are handled independently of the castings on the trucks. The room is 10 feet square and 7 feet high and 59 tons of castings are sand-blasted per day. The sand-blast machine was furnished by the Pangborn Corporation, Hagerstown, Md. The machine is designed specially for handling steel castings and is one of the several types manufactured by the Pangborn Corporation. The dust collector, sand conveyor and elevator were furnished by the W. W. Sly Mfg. Co., Cleveland. About 1,000 pounds of castings are piled on each truck and they are blasted in about 20 minutes. About three-quarters of a cubic yard of sand is added to the machine per day. The air pressure varies from 80 to 90 pounds per square inch, and this pressure has been found entirely satisfactory. Figs. 5 and 7 show two views of a steel freight-car coupler casting blasted by a Pangborn apparatus similar to that installed at the plant of the Sivyer Steel Casting Co. Fig. 5 shows the coupler as it came from the sand, and Fig. 7 illustrates the same casting after a few minutes' application of the sand-blast. It will not noted that although a large amount of badly burned sand and scale adhere to the casting, it was thoroughly cleaned and the cores completely removed.

Another interesting sand-blast room, installed in a western gray iron foundry, is shown in Fig. 18. This room is about 12 feet long and 10 feet wide with a headroom of 6 feet. The sand-blast machine is located inside

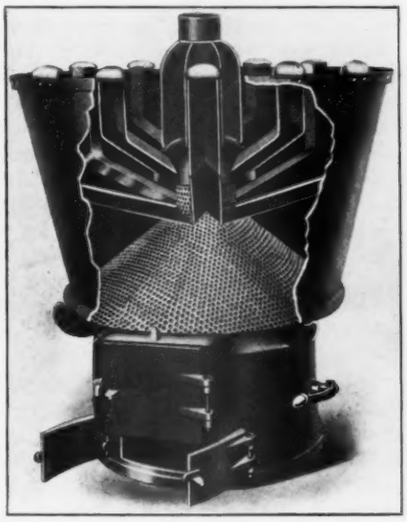


FIG. 31—SAND-BLAST SAND DRYER

in one corner of the chamber. One side of the room is provided with a large window giving plenty of light and doors are fitted at each end. The used sand falls into a pit underneath the room from which it may be removed easily by opening trap doors in the platform built at one end of the room. Unusually complete arrangements have been made for the rapid removal of dust. The room is ceiled with galvanized steel sheets which are formed into eight exhaust hoods, as shown in Fig. 18. Each of these hoods is connected by a 4-inch exhaust pipe to a 50-inch motor-driven fan placed outside. Three 4-inch exhaust pipes also are connected with each side of the pit under the grating. There are, therefore, 14 openings, eight in the ceiling and six in the floor through which the dust is removed. The exhaust fan is driven by a 15-horsepower, 220-volt motor running 650 revolutions per minute.

Interesting views of foreign sand-blast rooms are shown in Figs. 6 and 12, the former illustrating a German installation and the latter an English outfit. The English room is painted white and is provided with a glass roof, the work being illuminated by an electric arc lamp suspended over the roof. The German installation is provided with a saw-tooth roof and exceptionally large dust-exhaust connections.

Fig. 14 shows a novel arrangement of sand-blast rooms in an eastern steel castings shop. It will be noted that the sand is contained in a large steel bin suspended from the main roof rafters over the sand-blast rooms. This bin is provided with four hoppers from which the sand is conducted to the blasting machines.

For handling small castings the sand-blast barrel has many advantages including low first cost, ease of installation and freedom from dust. Fig. 16 shows a typical sand-blast barrel installation especially designed for handling malleable castings. The barrel at the right in this installation was furnished by the New Haven Sand Blast Co., New Haven, Conn., and that at the left was supplied by the W. W. Sly Mfg. Co., Cleveland. These machines will handle about 500 pounds of castings in from 15 to 20 minutes. Many foundrymen have established special departments for operating sand-blast barrels. A typical installation of this kind in a prominent Cleveland foundry is shown in Fig. 17. This installation includes one New Haven and four Tilghman-Brooksbank barrels. The general arrangement of the apparatus is clearly illustrated. An enclosed sand-blast barrel, built by the Hoevel Mfg. Corporation, New York, is illustrated in Fig. 24. The

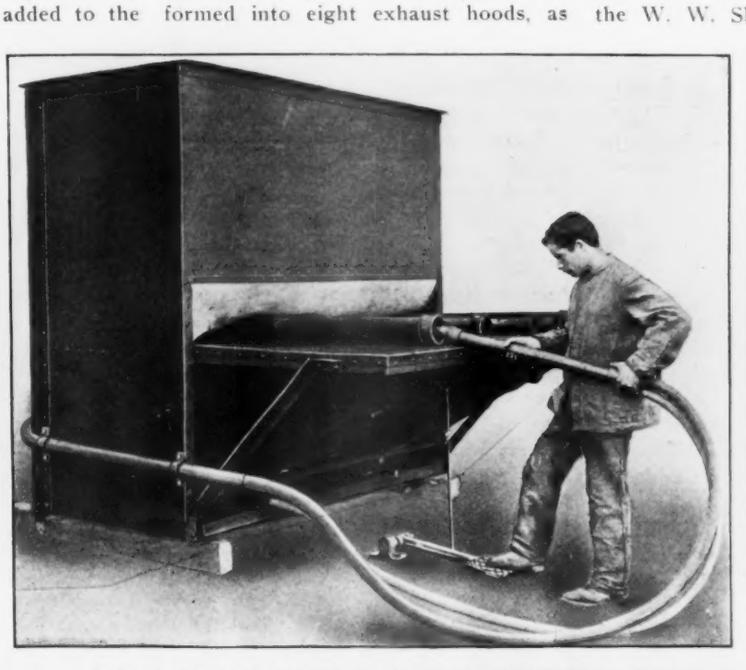


FIG. 32—SPECIAL MACHINE FOR SAND-BLASTING PIPE

barrel rotates at one or two revolutions per minute, the purpose of the rotation being simply to turn the pieces. The nozzles are stationary and the barrel is provided with obliquely shaped side walls which aid in bringing the castings constantly under the sand-blast.

An interesting self-contained sand-blast barrel recently has been developed by the American Foundry Equipment Co., New York. This apparatus is provided with an automatic, pneumatic sand return system that does away with the use of overhead hoppers, bucket elevators, etc., for handling the sand. At the same time the design provides for a reduction of the air consumption to a minimum. A sand-blast barrel developed by the Badische-Maschinenfabrik, Durlach, Germany, is shown in Fig. 23.

As mentioned previously, the rotary-table sand-blast machine was developed primarily in Germany. Figs. 22 and 26 show two typical German installations. The former is interesting on account of the rather novel dust-collector arrangement suspended over the machine. An American development of the German machine, shown in Fig. 26, is illustrated in Fig. 27. The latter machine, which is sold in the United States by the Hoevel Mfg. Corporation, New York, is entirely self-contained.

The capacity of a rotary-table sand-blast machine does not depend entirely upon the size and the weight of the pieces to be cleaned, but to a large extent on the manner in which the surface of the table is utilized. In order to obtain the highest efficiency, the table should be covered very closely and the open spaces should be filled up with small castings. This will not only increase the output, but will also save the surface of the table from unnecessary wear.

For meeting unusual conditions, various special types of sand-blasting apparatus have been developed. Fig. 32 shows a German cabinet-type machine designed for cleaning cores from pipes or tubular castings. The general arrangement of this apparatus is clearly shown in the illustration. Fig. 25 illustrates another style of cabinet machine especially designed for cleaning radiator columns. This machine is equipped with an endless moving table on which the castings are placed, the table being loaded at one end of the cabinet and unloaded on the other. This machine is equipped with stationary nozzles, and two dust exhaust connections.

For sand-blasting car wheels the special apparatus shown in Figs. 28 and 29 has been developed. This machine is in use at the plant of the National Car Wheel Co., West Holmestead, Pa. The company now is making 600 33-inch car wheels a day, weighing from 625 pounds to 840 pounds each. Both sides of the wheel are cleaned at the same time at an average rate of one wheel in 17 seconds. Three men are in charge of the sand-blasting; one man rolls the wheels into the machine, another removes them and the third works the sand-blast. As high as 650 wheels have been cleaned in this machine in a day. The machine is operated by a 7-horsepower Westinghouse motor. The sand is fed from a large storage room in the cellar to a reservoir above the machine by a Sturtevant No. 6 fan. A 15-horsepower motor operates the fan, which also is used to remove the dust. The reservoir has a capacity of about five bushels.

Sand-Blasting Car Wheels

After a car wheel is rolled into the machine, the operator opens a valve connected with a tank carrying 25 pounds air pressure. Two hose and pipe connections tapering from 4 inches to ¾-inch in diameter, lead from the tank to each side of the sand-blasting chamber, making it possible to clean both sides of the wheel in a single operation. The nozzles are lowered and raised from the rim to the hub of the wheel by a lever operated by hand. The surplus sand is carried from the chamber by small buckets attached to an endless belt. A steel curtain is lowered after the wheel is rolled into the chamber, to protect the operators from the dust. This machine was designed by the Tilghman-Brooksbank Sand Blast Co., Philadelphia.

Special machines may be provided to handle castings of almost any size. Standard sand-blast barrels will conveniently take castings weighing up to 35 or 40 pounds. The rotary-table type of machine will handle castings up to about 100 pounds in weight. When heavier castings are to be sand-blasted, it is customary to use a special machine, if there is sufficient duplicate work, or a sand-blast room.

The value of the sand-blast as a cleaning agent depends upon the quality of the sand used and this item may become an important one in the expense of operating the apparatus. The sand should be hard and clean, also free from all clay, soil, mica and other substances which tend to create dust and have no abrasive power. Considerable difference of opinion exists as to whether a sharp sand is necessary, although the trend of thought seems to be that such qualities as hardness and resistance to the shock of impact are more essential than mere sharpness. In other words, it is generally believed that it is the impact of the moving particles of sand that does the work, cutting action being negligible. While some authorities claim that sand-blasting is a purely peening operation, there seems little doubt that there is considerable abrasive action as well. In this connection, the proper distinction should be made between abrasion and cutting.

Figs. 19, 20 and 21 show typical sand-blast sands used in the United States. These sands are selected for their uniformity in size, their hardness and wearing qualities. Among the principal miners and distributors of sand-blast sand in the United States are the Cape May Sand Co., Cape May, N. J.; J. W. Paxson Co., Philadelphia; Pangborn Corporation, Hagerstown, Md.; Pettinos Bros., Bethlehem, Pa.; Portage Silica Co., Youngstown, O.; U. S. Silica Co., Chicago, Ill., and the Wedron Silica Co., Ottawa, Ill.

Instead of sand, steel shot is quite extensively employed. Metallic shot or crushed steel has a specific gravity of about two and one-half times that of sand. For this reason the impact is heavier and this material also is said to have unusually satisfactory wearing qualities. Among the principal manufacturers of sand-blast grit and shot, together with crushed steel for sand-blasting are the Pittsburgh Crushed Steel Co., Pittsburgh, and the Globe Steel Co., Mansfield, O.

If wet sand is shipped, it should be dried before it is placed in the machine either by spreading it over a large area, as the floor of a shed, or by using a dryer of special construction. A hopper dryer erected around a small stove or steam coil may be employed. It is generally considered more satisfactory to install a specially constructed dryer which usually will perform the work more satisfactorily than a home-made apparatus.

An interesting form of sand dryer manufactured by the Pangborn Corporation, Hagerstown, Md., is shown in Fig. 31. This apparatus is designed to keep the wet sand from direct contact with the fire box and to carry away the moisture during the drying process by air currents. This is accomplished by the use of a perforated cone-shaped screen, the neck of which surrounds the chimney. A suitable air space is provided between the cone and the fire box. As fast as the sand is dried it drops through the perforations in the screen onto the inclined surface of the fire-box from which it falls onto the floor. As the sand resists the passage of air and heat, a number of inverted angle-flues project from the fire box through the sand to the top of the hopper. This permits the hot air to absorb the moisture of the sand and to discharge it through these flues.

Among the various items of sand-blast equipment that are subject to wear the hose is an important element. Only

the best qualities of rubber hose especially made with a thick inner wall of pure rubber will withstand the cutting action of the sand for any length of time. Any grade of hose may be used, but that which is not reinforced internally will not last long. In actual service, it will be often found that the wear on the hose is fully as great on the outside as within due to its being dragged over rough castings. If care is taken to prevent this, or if the hose is armored, its life will be lengthened materially. An excess of oil in the air will attack the rubber in the hose and injure it materially. The best of hose may be spoiled by the operator kinking it under his arm, a convenient and very destructive method of stopping the flow of air and sand. This habit should be guarded against. At the end of the day, the hose should be hung up in a curved hanger attached to the side wall of the sand-blast room.

Among other important sand-blast accessories are gloves and helmets. The latter have been greatly improved in recent years and today helmets may be secured which are virtually dust-tight. The earlier types of helmets frequently were fitted with glass windows, but they were soon found to be unsatisfactory owing to the abrasive action of the flying dust particles. The sand-blast helmet manufactured by the Multi-Metal Separating Screen Co., New York City, is provided with a window consisting of four multiple screens which will admit light and air and at the same time prevent the sand from sifting into the helmet.

It will be found that ordinary gloves will not last long in the sand-blast room. Extra heavy gauntlets are preferable. The special sand-blast gloves manufactured by the Hickory Steel Grip Glove Co., Chicago, are made of chrome tanned horsehide reinforced with strips of napa leather which are fastened with small steel ribbons clinched on the inside.

Goggles frequently are necessary to prevent eye injuries resulting from sand-blast operations. Among the manufacturers of goggles suitable for sand-blast purposes are the Julius King Optical Co., New York City; the Tilghman-Brooksbank Sand Blast Co., Philadelphia, and the Strong-Kennard & Nutt Co., Cleveland. Respirators also are necessary under certain conditions, although they should not be required if proper provisions are made for exhausting the dust from the sand-blast room.

The total production of cast iron gas and water pipe and fittings and cast iron soil and plumbers' pipe and fittings in Canada in 1915, is estimated at 53,700 net tons, as compproper provisions are made for exhausting the dust from the sand-blast room.

Coke By-Products in 1915

The recovery of the valuable by-products from American coke manufacture made big advances in 1915 and has now attained the proportions of an important industry. The value of these by-products last year was nearly $30,000,000, a large increase over the previous high-water mark of $17,500,000 in 1914. Although there were material increases in the output and value of gas, tar, and ammonia, which was to be expected with a greater output of by-product coke, the increase in benzol products was remarkable and presented the most interesting feature of the year in the coke industry. The value of these products rose from less than $1,000,000 in 1914 to more than $7,760,000 in 1915, according to C. E. Lesher, of the United States Geological Survey, Department of the Interior. Benzol has been recovered in this country from coke-oven gas for a number of years, but prior to 1915 the market was small and the prices low.

In 1914 there were 14 benzol plants in the United States, but they were all controled by one company, and therefore it is not feasible to publish the statistics of their production for that or previous years. Last year 16 additional coke plants were equipped with benzol apparatus, and the output was very greatly increased. The incentive for putting in this equipment was, of course, the opportunity to contract at war prices for benzol and other similar materials for use in making explosives for the European countries. When the demand from that source shall have ceased, the United States will be in possession of a large supply of the raw materials from which dyes and chemicals are made and will be able, if trade conditions are right, to enter into the manufacture of these essential materials on an ever-increasing scale. The prompt and successful manner in which, in 1915, under favorable conditions, the producers increased the benzol supply and entered the field of dye manufacturing on a larger scale than ever before demonstrates the fact that in this country technical ability and business courage are not lacking and promises well for the future progress of the industry.

The benzol products obtained in 1915 amounted to 16,600,657 gallons. More than 13,000,000 gallons of the total output was reported as crude light oil and had an average value of 33 cents. Some of the plants have their own stills and refineries, and the pure benzol reported from those sources amounted to 2,516,483 gallons, with an average value of nearly 57 cents, at least three times the value of crude benzol before the war, and 623,506 gallons of toluol, with an average value of $2.45 a gallon. Crude benzol, which in 1914 was used to some extent for motor fuel, contained the toluol, which is now separated out and sold at fancy prices.

More than 138,000,000 gallons of tar were obtained from coke ovens and sold for $3,568,384 in 1915.

The ammonia, of which nearly 100,000 tons were reported as sulphate and the remainder as liquor (10,626,612 gallons) and anhydrous ammonia (30,002,196 pounds), brought a total of $9,867,475 to the producers. Surplus gas to the extent of 84,356,000,000 cubic feet, valued at $8,625,000, was sold or used. Of that quantity, 17,196,000,000 feet was used as illuminating gas, 27,591,000,000 feet as domestic fuel, and 39,569,000,000 feet as fuel for steam raising, open hearth furnaces, gas engines, and other industrial purposes. These by-products, which had a total value of $29,824,579, were obtained by the carbonization of 19,500,000 tons of coal, from which was also obtained 14,000,000 tons of coke, valued at $48,500,000. The total value of the coke and by-products was more than $78,300,000.

Hot Iron Wanted

By W. J. Keep

Question:—We are anxious to obtain hotter iron than we have been securing. Our cupola has a 72-inch stack, which is lined to 48 inches. The tuyeres are 3½ x 8 inches, spaced 5 inches apart. Our blast pressure generally is 10 ounces and the coke bed consists of 1,250 pounds, which extends 21 inches above the tuyeres. The first iron charge consists of 3,000 pounds and the subsequent charges are 2,000 pounds with 225 pounds of coke between charges. Our positive pressure blower is located 40 feet from the cupola and is connected by a 22-inch pipe. We experience considerable difficulty in obtaining clean castings. We melt a very hard iron which contains a small percentage of steel scrap.

Answer:—Nothing in your inquiry gives a reason for dull iron. If anything, the iron should be too hot and the melting should be slow. You should slag your cupola and use enough good limestone to make the slag fluid. In charging be careful not to charge dirt from the scaffold floor. You are using too much coke. If you are melting 15 tons, your ratio is 7 to 1, but you must not reduce the coke until you get the iron as hot as you want it. If your iron is hot, it will probably be clean.

THE BRASS FOUNDRY

Chemistry in the Brass Foundry---IV

By E P Later

NEXT to copper, zinc is one of the most useful and important of the metals from the brass foundrymen's standpoint. Brass contains, roughly, from 15 to 50 per cent or more of zinc, while the bronzes, which are technically alloys of copper and tin, are rarely found without at least a small amount of zinc and often this is present in greater quantities than the tin, largely with the idea of making a better and less costly alloy. In addition, zinc is found in considerable amounts in a large variety of other alloys, white metals, die-casting alloys, and so on, and finally, tremendous amounts of the commercially pure metal are used for galvanizing and protecting all manner of steel and iron parts from corrosion. There is, consequently, frequent need of some means of determining the amount of this metal in an alloy or other material.

Titration Method of Estimating Zinc

One of the best known methods of estimating zinc is by titration with a solution of potassium ferrocyanide, the addition of this reagent, under the proper conditions, to a solution of a zinc salt finally resulting in the precipitation of a white ferrocyanide of zinc and potassium. Uranium acetate is used as an outside indicator, the production of a brown color being evidence that a slight excess of the ferrocyanide has been added and the titration, therefore, is finished.

The standard solution of ferrocyanide required for this determination may be prepared by weighing out 21.6 grams of pure potassium ferrocyanide and dissolving it with 7 grams of sodium sulphite crystals, in sufficient distilled water, finally diluting to exactly one liter with distilled water in a volumetric flask, shaking well to insure thorough mixing.

The indicator also may be made up at the same time by dissolving about 4.5 grams of pure uranium acetate in 100 cubic centimeters of distilled water, adding two cubic centimeters of acetic acid to clear the solution.

Protecting Zinc from Oxidation

The ferrocyanide must be standardized before use and for this purpose two samples of pure zinc, about 0.3 grams each, should be weighed out and placed in 8-ounce flasks. It may be noted here that unless pure, granulated zinc is well protected from the air of the laboratory there may be some oxidation or corrosion, which will be the source of some error in the calculations; therefore it has been recommended that the zinc be prepared by pouring over it a dilute solution of ammonia containing a small quantity of ammonium chloride, warming gently and letting it stand for several hours. The liquid then may be poured off, the zinc washed with distilled water several times and finally with strong alcohol and well dried.

If desired, pure zinc oxide may be used for standardizing instead of the pure metal, but before weighing out a quantity of it, it should be placed in a crucible and heated to redness for a few minutes, then cooled in a dessicator; 0.3734 gram of zinc oxide contains exactly 0.3 gram of zinc, and therefore, if this amount is taken the calculation will be simplified.

The samples of zinc or zinc oxide are dissolved in 10 cubic centimeters of strong hydrochloric acid, the sides of the flasks are washed down with a jet from the wash bottle, then a small piece of litmus paper put in and the solution is made faintly alkaline with ammonia. Hydrochloric acid then should be added to slight acidity, followed by 8 cubic centimeters excess of the strong acid, the solution diluted to about 250 cubic centimeters and heated nearly to boiling. It is then ready for titration with the ferrocyanide solution, using the solution of uranium acetate as an outside indicator, on the spot plate or a sheet of white paper.

In carrying out the titration it is best to pour off about a third of the zinc solution and set it aside in a beaker, then run a few cubic centimeters of the ferrocyanide at a time into the rest of the solution, stirring thoroughly after each addition, until a drop taken out and placed on a drop of the uranium solution shows a brown color; this is an indication that an excess of it has been run in. The greater portion of the reserved solution is now added and the titration continued until the endpoint is again passed. The last of the reserve portion is added, and to save rinsing, a large part of the solution is poured back into this beaker; then this is added to the main portion and the titration is finished carefully, testing after each addition of two drops of ferrocyanide and finally stopping at the appearance of a faint, permanent brown. A sharper endpoint may be obtained by taking a quantity of the solution, equivalent to several drops, for testing, toward the end of the titration, as the amount of zinc lost will be very small. When the final brown color is obtained, the burette reading should be noted and the spot plate watched for a minute or so to see if some of the preceding tests do not develop a color, as the real endpoint is always passed by a few drops and a correction must be made for this. It is advisable to make a blank test, using the same amount of solution and under the same conditions, except that no zinc is present, to determine the quantity of ferrocyanide which is required to produce the brown color; this must also be subtracted from the burette reading.

Finding the Value of the Solution

Knowing the weight of zinc taken and the quantity of ferrocyanide required to precipitate it, the value of the solution may be found by dividing the weight of zinc by the number of cubic centimeters run in, minus the corrections mentioned.

The ferrocyanide solution is sensitive to light and tends to decompose; therefore, it should be kept in a cool, dark place. It is also well to re-

standardize it now and then, to insure the best results.

The ferrocyanide method has, however, the unfortunate disadvantage that unless considerable care is taken to keep all of the conditions always the same, both during standardization and subsequent titrations, more or less sizeable errors will be introduced. Until an operator has had some experience with it he is liable to go astray and obtain results of doubtful value. The point is, that while the method is capable of yielding very accurate results, when properly carried out, some little skill and experience are required to obtain them consistently.

Several other volumetric methods have been proposed for the estimation of zinc, but as none of them is as satisfactory as the ferrocyanide method, it would hardly be worth while to discuss them here.

Gravimetric Estimation

In the way of gravimetric estimations a greater choice of fairly satisfactory methods is offered, and of these one which involves precipitation of the metal as zinc-ammonium phosphate is, in some ways, perhaps the best method for the estimation of zinc.

When using this method the zinc is finally obtained as pure zinc sulphide, all of the other metals having been removed by methods which will be given later. This sulphide is dissolved in about 10 cubic centimeters of strong hydrochloric acid and 35 cubic centimeters of water, heating until the zinc is all in solution. The latter is then allowed to cool and 50 cubic centimeters, or more, of a solution of sodium ammonium phosphate are added. This is prepared by dissolving 10 grams of the pure salt in 90-100 cubic centimeters of distilled water.

The zinc solution now should be carefully neutralized with ammonia, that is, the latter should be added slowly and with constant stirring until neither red nor blue litmus paper changes color appreciably when dropped into the solution; a slight excess, one or two drops of ammonia should be put in, then about 1 cubic centimeter of acetic acid is added, to produce a slight acid reaction. Care should be taken to see that the solution really is slightly acid. It is important that the reaction of the zinc solution be adjusted carefully as the precipitate of zinc-ammonium phosphate is soluble in an excess of both ammonia and acid.

The solution next should be heated, but not boiled, for an hour or so, or until the precipitate has become granular and settled out; then it may be filtered off, washing thoroughly with hot water, finally drying the filter and precipitate in an oven. The precipitate should be carefully brushed into a crucible or watch-glass and the small particles adhering to the filter paper dissolved by pouring a few drops of dilute nitric acid over it, allowing the acid to run into a weighed porcelain crucible or small dish. This solution should be evaporated to dryness by careful heating, then the main body of the precipitate added to it and the whole heated gently for a few minutes at a low, red heat. If desired, a Gooch crucible may be used instead of a paper filter; the manipulation is the same as before, the crucible being supported on a platinum crucible cover during the heating of the precipitate, or it may be pushed half way through a hole cut in a sheet of asbestos which rests on the edges of a larger crucible, the flame of a bunsen burner serving to heat this.

In any case the crucible is allowed to cool in a dessicator and weighed. The precipitate, zinc pyrophosphate, contains a little less than 43 per cent zinc; therefore, by multiplying its weight by 0.4291 the result is the amount of zinc in grams, from which the per cent present in the sample may be calculated.

Estimating Zinc Electrolytically

Zinc also may be estimated electrolytically, if desired, although this procedure has certain disadvantages which rather militate against its use. Assuming that the zinc is present as the sulphate in a solution free from other metals, the solution should be poured into an electrolyzing beaker of about 300 cubic centimeters capacity and all free acid neutralized by the careful addition of potassium hydroxide solution, stirring well each time. About 50 cubic centimeters of potassium oxalate solution and then 100 cubic centimeters of potassium sulphate solution should be added. These are made up to contain 166 grams of potassium oxalate and 250 grams of potassium sulphate per liter, respectively. The zinc solution will then be ready for electrolyzing, but before doing so it will be advisable to plate the platinum screen, or dish if this is used, fairly heavily with copper, which may be easily done by adding an excess of ammonium oxalate solution to a saturated solution of copper sulphate, thereby forming a double salt of copper and ammonium, warming to about 170 degrees Fahr. and, after making slightly acid with oxalic acid, electrolyzing as usual. The electrodes should be cleaned beforehand, of course, but the screen need not be weighed until it has been coated with the copper; then it should be rinsed in distilled water, dried with alcohol and ether and weighed.

The reason for this extra manipulation, in the way of coating the cathode, is that the zinc deposit produced is very hard to remove, black stains which can be removed only with the greatest difficulty being formed on the screen. The application of the copper previously, however, eliminates this trouble; the subsequent removal of the zinc deposit does not injure the copper coating very much and it will be capable of serving for several determinations.

Electrolysis of the Zinc Solution

Coming back to the electrolysis of the zinc solution, the apparatus should be set up and a current of about 0.3 ampere passed through until the zinc is completely removed, which may be determined by placing one or two drops of the solution on a piece of black paper or other black surface and touching them with a drop of potassium ferrocyanide solution, when the absence of a white precipitate or cloudiness will be evidence that all of the zinc has been deposited.

The screen then should be taken out of the solution without breaking the current, washed in distilled water, dipped in alcohol and ether, dried and weighed. The increase in weight, of course, is the metallic zinc which was deposited, from which data the per cent present in the sample may be calculated.

The zinc may be removed from the screen by immersing it in nitric acid diluted with several times its own volume of water; the copper coating will not be attacked appreciably and after washing, drying and weighing, may be used again.

To avoid the necessity for plating the cathode each time, a zinc determination is made; if other metals are estimated in the meantime, a silver screen or dish may be used to advantage. Silver is much cheaper than platinum and for this particular case will serve equally well or better. One of the advantages of having two sets of electrolyzing apparatus is that two determinations may be run simultaneously, with a considerable saving in time. In removing the zinc from a silver cathode, however, it must be remembered that silver is also attacked more or less readily by nitric acid; therefore, care should be taken when using it, or it may be replaced by hydrochloric acid, which does not attack the silver so strongly.

The procedure involved in the application of the foregoing methods to the estimation of the zinc in an alloy, varies somewhat according to the composition of the latter, but the principle is the same in all cases, namely, to remove all of the metals which would interfere with the determination, after which it is not very difficult to obtain the zinc in some form which can be weighed and the amount present calculated.

When zinc only is to be determined in an ordinary brass or bronze the following treatment will be found satisfactory for all the methods given and should be carried out: About one gram of the alloy should be dissolved in 10 cubic centimeters of strong nitric acid in a flask, heating gently until the red fumes are expelled. It may be necessary to add a few cubic centimeters of strong hydrochloric acid and to heat for a few minutes, to insure complete decomposition of the alloy. Five or six cubic centimeters of strong sulphuric acid should be added and the flask heated over a free flame, giving the flask a whirling or rotating motion, until the white fumes of sulphur trioxide come off freely, after which the liquid may be allowed to cool. About 35 cubic centimeters of distilled water then may be added and heated to boiling, keeping it hot until all soluble matter is in solution. The precipitated lead sulphate then may be filtered off, catching the filtrate in a large beaker, say 250 cubic centimeters capacity, and washing the filter with hot water. Six or eight cubic centimeters of sulphuric acid should be added to the filtrate and a piece of thick sheet aluminum an inch or so square, put in and the whole boiled for 10 or 15 minutes. A precipitate consisting of finely divided copper, lead and so on will form, while any iron present will be reduced to the ferrous state; the liquid should be filtered through a filter containing a piece of aluminum, into a beaker in which another strip of the same metal has been placed, then allowed to cool, a drop of methyl orange indicator added and the solution neutralized by adding carefully a solution of sodium bicarbonate until it takes on a light yellow color. A dilute—about 20 per cent—solution of formic acid next is added until the liquid just turns pink, followed by an excess of five drops. The solution should be diluted to 300-400 cubic centimeters, the best results being obtained by having it equal 100 cubic centimeters for each 0.1 gram of zinc probably present, and, if much iron is present, add 2-4 grams of ammonium sulphocyanate, remove the aluminum strip, heat nearly to boiling and pass hydrogen sulphide gas through to saturation. The white precipitate, zinc sulphide, may be allowed to settle for a few minutes, then is filtered off and is washed with hot water.

If the volumetric method is to be used, the precipitate is carefully transferred to a large beaker and dissolved by adding about 10 cubic centimeters of strong hydrochloric acid and 30 cubic centimeters of distilled water and heating gently. Any precipitate adhering to the filter may be removed by pouring a few drops of the acid over it, and rinsing off with a jet from the wash bottle. Three or four grams of pure ammonium chloride then are added, the solution is diluted to 250 cubic centimeters, heated to 60 degrees Cent. and titrated with the standard solution of potassium ferrocyanide.

When the gravimetric method is to be followed out, the precipitate of zinc sulphide is dissolved in strong hydrochloric acid, adding about 35 cubic centimeters of distilled water and heating, then allowing it to cool and adding a solution of sodium ammonium phosphate, with the subsequent operations as described under the gravimetric method.

The procedure when the electrolytic method is used is somewhat different from the two preceding cases in that the well washed precipitate is transferred, with the filter, to a six-ounce flask and heated with 10 cubic centimeters of strong sulphuric acid and 35 cubic centimeters of water until the zinc is all in solution, after which it is heated over a free flame until white fumes come off freely. It is then allowed to cool, 25 cubic centimeters of water added and the whole heated until all soluble matter is in solution; then it is poured into a 300 cubic centimeter electrolyzing beaker, the free acid neutralized by potassium hydroxide solution and the rest of the determination is conducted as directed under the electrolytic method.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Acid-Resisting Bronze

We would like to know what bronze mixture will satisfactorily resist muriatic acid. Would an alloy consisting of copper, 77 per cent; tin 8 per cent and lead, 15 per cent give satisfactory results?

The alloy given is as good as any for the purpose mentioned. All bronzes are more or less oxidized by acids.

High Compression Bronze Alloy

We would like to have you furnish us with a mixture for a bearing bronze which should have a tensile strength of 38,000 pounds per square inch; yield point, 22,000 pounds per square inch and an elongation of about 24 per cent. We would also like to have a formula for an alloy which would yield, by compression test, 0.001 inch under a load of 10,000 pounds per square inch.

The following alloy frequently is used for bearing purposes and when properly made will meet the specifications given: Copper, 90 per cent; tin, 6.5 per cent; lead, 1.5 per cent and zinc, 2 per cent.

The following alloy will meet the compression test: Copper, 72 per cent; iron, 12 per cent; aluminum, 15 per cent and manganese, 1 per cent.

Copper Castings With High Tensile Strength

We would like to know how to make copper castings, such as shell bands, 9 inches in diameter, 3-inch face and ¾-inch thick. The tensile strength specified is 30,000 pounds per square inch. The castings which we have produced thus far are exceedingly porous.

You will be unable to obtain a tensile strength of 30,000 pounds per square inch from cast copper. This specification can be met only by rolled copper and the fact that it is demanded indicates that rolled copper is required. The cast copper bands used for shells are cast oversize and they are then rolled

to the correct size, the metal then practically constituting rolled copper. After the bands are rolled they are annealed to insure the requisite degree of softness to pass bending tests. These bands also must have an elongation of approximately 40 per cent. Porosity in copper castings can be overcome by the addition of 1 per cent of a 10 per cent alloy of silicon-copper.

Difficulties Due to Segregation

We are experiencing considerable difficulty in obtaining sound castings for valves subjected to pressure of from 5,000 to 10,000 pounds. Leakage develops in the interior of the valves and we would like to know what can be done to insure sound metal.. The mixture we are using consists of copper, 86 per cent; tin, 10 per cent; lead, 2 per cent and zinc, 2 per cent. The metal is carefully melted under a cover of charcoal. We would also like to know whether it would be advisable to feed this casting by use of a heavy riser or by chilling some part of the wall section.

The difficulty in obtaining sound castings in this instance is due to the lack of density in the metal caused by a segregation of the constituents of the alloy during a period of slow cooling which produced what might be termed a *pithy* condition of the metal which is porous to water under pressure. Rapid chilling and more perfect feeding will remedy the trouble. This involves the use of chills on the heavier sections of the casting to carry away the heat rapidly and to permit the casting to cool uniformly and as quickly as possible. In addition, large risers should be employed. The more rapidly the casting is solidified, the denser will be the grain, and in this case, more risers should be used, even if some of these are comparatively small. The addition of nickel to alloys subjected to high pressures is advantageous. The mixture which you give would be improved by the addition of two parts of nickel in place of an equal amount of copper. The use of a deoxidizer, such as 30 per cent manganese-copper in the proportion of 0.25 per cent. is advisable.

A Commercial Brass Alloy

We would like to have an alloy that can be used for a wide variety of castings and which can be machined readily. It should contain at least 85 per cent of copper and the proper proportions of zinc, tin and lead.

An excellent alloy for the purpose outlined, follows: Copper, 85 per cent; tin, 5 per cent; lead, 5 per cent and zinc, 5 per cent.

Permanent Molds for Lead Toys

We have received an order for lead toys, principally animals, about 2½ inches long. We would like to know whether they can be cast in brass permanent molds. What method should be followed in producing the permanent mold, and let us know whether you suggest iron or brass? Is it possible to use plaster of Paris as a mold for pouring the brass, permanent mold casting?

We advise the use of bronze molds for making lead toys. To produce a permanent mold, it will be necessary to obtain a pattern, then to make a mold in sand from the pattern, into which the bronze is poured. The pattern can be made of plaster of Paris by casting the latter around the metal in the form of a piece mold, which, when separated and trimmed, is used as a master pattern for making the molds for the bronze sections. However, plaster of Paris cannot be used in place of molding sand for making the castings that are to form the bronze molds.

A Mixture for Yellow Brass Anodes

We have endeavored to make yellow brass anodes for plating purposes, but thus far we have not experienced any great degree of success. The mixture from which these were made consisted of copper, 60 per cent and spelter, 40 per cent. When the anodes were placed in the plating vats they turned black and did not deposit the metal.

The mixture generally employed for making yellow brass anodes follows: Copper, 66 per cent, and zinc, 34 per cent. Neither tin nor lead is used in this mixture. The difficulty which you are experiencing is probably due to causes other than the composition of the metal.

Casting Copper in Permanent Molds

We have an order for a large number of copper tubes, 24 inches long, 9 inches in diameter and ¾-inch thick. These tubes must be absolutely free from blow-holes and other defects and are to be cast from pure copper. We have considered casting these tubes in permanent molds with an open top, having the metal enter at the bottom. The molds would be made in two parts with collapsible cores. Kindly let us know whether this method of casting would prove satisfactory and also how to melt metal to obtain pure copper castings.

You should experience no difficulty in casting pure copper in permanent molds, although, owing to the chilling effect of the iron, the copper will not flow with the same freedom as in sand molds. For this reason, if the bushing fails to run when gated at the bottom, it may be necessary to gate it at the top. The copper should be melted with an ample quantity of granulated charcoal, together with a small amount of salt, and when it has reached the proper pouring temperature, 1 per cent of 10 per cent silicon-copper should be added to insure castings that will be free from porosity.

Sulphuric Acid Resisting Alloy

We would like to have a mixture for castings that will resist the action of sulphuric acid. We have heard that an alloy consisting of aluminum, 92 per cent; copper, 5 per cent; bismuth, 2 per cent, and silicon, 1 per cent, gives good results. Before proceeding to make this mixture, we would like to know whether this alloy is satisfactory for this service, and if so, what should be the sequence of the metal additions?

We are unable to state whether the alloy given would withstand sulphuric acid or not, and we never have tested it. The bismuth could be replaced by a small amount of antimony and the silicon omitted, since the latter element is a harmful impurity in aluminum or its alloys. An alloy consisting of 85 per cent aluminum and 15 per cent of tin is reported to possess great acid-resisting properties.

Mixture for Aluminum Pistons

We have experienced some trouble in making aluminum pistons for automobiles and we would like to have you suggest a suitable mixture for this work.

The following alloy is used largely for the purpose stated: Aluminum, 95.75 per cent; copper, 2.50 per cent; iron, 0.75 per cent; tin, 0.75 per cent, and magnesium, 0.25 per cent. The iron should be added in the form of tin plate, being melted with the copper. Complete fusion and amalgamation is effected by the addition of aluminum to form a hardener, which subsequently is melted with the proper percentage of aluminum to obtain an alloy of the proportions recommended.

A Light, But Strong Aluminum Alloy

We would like to have you furnish us the mixture for a light aluminum alloy suitable for castings, combining maximum toughness and malleability, which to a certain extent might be substituted for wrought iron.

The following alloy will be suitable for the purpose outlined: Aluminum, 80 per cent; zinc, 15 per cent; copper, 3 per cent, and tin, 2 per cent.

Elements of Casting Copper-Base Metal on Iron

The Many Difficulties of This Process Are Explained in Detail and Methods of Doing the Work Successfully Are Outlined

By Russell R Clarke

HAVING noticed the subject of burning copper onto iron referred to in the question and answer department of the trade publications three times within the past year, it has occurred to the author that an article, also from experience and going into more minute detail than the magazine answer could logically observe, might chance upon its element of interest. With many foundries the occasion for such practice is a rarity, if indeed, in great measure, not entirely a novelty. It has its exclusive features and considerations, which are well worth knowing, whether accommodating an immediate demand for practical application or not.

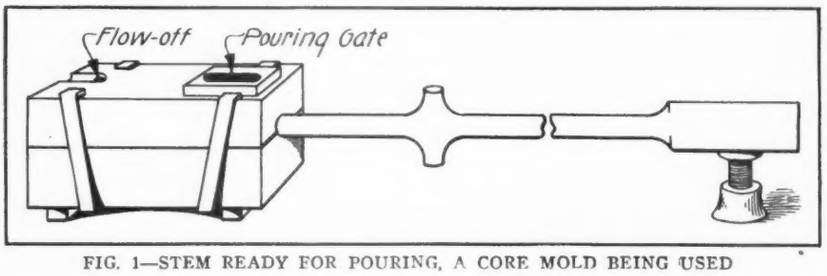


FIG. 1—STEM READY FOR POURING, A CORE MOLD BEING USED

At the beginning we desire our contention of experience to be definitely understood as having nothing to do with that *know it all* spirit of egotism. Neither does it purpose the impression of undue scope in its covering. To be at once explicit, we have had a fairly successful experience in casting brass and bronze on iron and one covering at least a representative variety. At any rate, this experience has been identified with work highly practical and particular and has been such in extent as to uncover a few facts in matter of detailed consistency in practice, and to reveal at least a conservative idea of method and procedure as affecting different types of metal used in casting, and variety in size, form and purpose of the completed product.

Many features not native to ordinary molding practice form a part of this burning-on process. It is not simply a case of shrinkage-rule measurement in fixing pattern dimensions, of making your mold in the ordinary way and setting your iron rod as you would a core therein, or of gating and pouring in accustomed style and then shaking-out a good casting. From all this it represents a digression and must be handled accordingly.

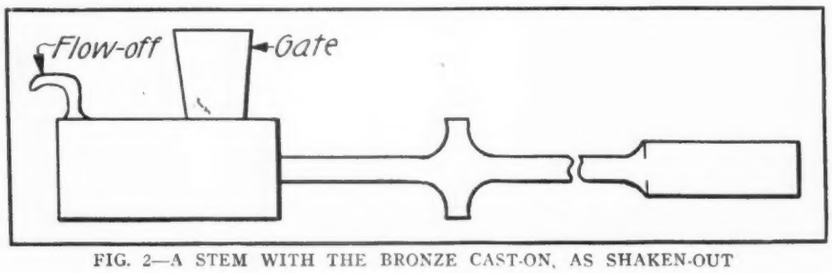


FIG. 2—A STEM WITH THE BRONZE CAST-ON, AS SHAKEN-OUT

The first essential is a mold impression admitting sufficient surrounding metal to insure free running in pouring, a *catching* burn-on, clean finishing limits and ample strength to resist the cracking superinduced by different degrees of expansion and contraction between the surrounding metal and the iron it encloses. These forces, it must be remembered, are two of the most uncompromising and irresistable known and must be seriously reckoned with in all cases where their activity is involved. Ample thickness of surrounding metal is imperative to results. You cannot rest assured of a good job in burning-on to a 2-inch diameter rod, for instance, from a pattern 2⅜ inches in diameter, thus affording a 3/16-inch thickness of metal all around. In such a case you would do well to run the mold in full, let alone burn onto the iron, avoid a seam, or find clean metal under a 1/32 or 1/16-inch cut of the machine tool. There is always a strong tendency to porosity in the metal due to unrest occasioned by the hand and solid iron core and the greater the bulk the stronger the pressure operating against this unrest. By far the better plan is to increase this metal bulk to that point where results are more logical of assumption. On the rod in question, admitting say 12 inches of linear surrounding metal, the dimension of the pattern should be at least from 2¾ to 3 inches in diameter to guarantee this logical assumption of results. The metal will then pour better, burn harder, rest more content and finish cleaner.

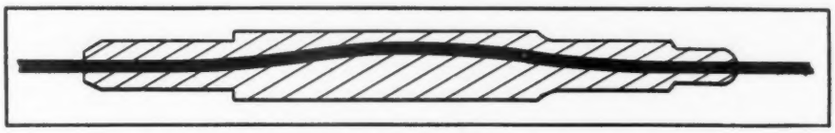


FIG. 3—THE RESULT OF NOT ANCHORING THE IRON ROD

To pattern construction as applying to green sand molding, several ideas are present to consideration. It can consist of two half-round shell patterns of proper dimensions, one of which can be temporarily attached to the rod in ramming up the drag and the other placed in coinciding position in manipulating the cope of the mold, or it can be a solid pattern bushing with a central hole large enough to permit slipping it over the rod when of uniform thickness. However, in most cases, an ordinary split bushing pattern with regulation core prints attached will be found quite efficient for the purpose. After completing this bushing mold in the customary way, these prints can be extended in a straight line and to rod-accommodating length by simply in-

creasing their length in the sand with an ordinary gate knife, there being no great necessity for strict conformity in points beyond the prints as made by the pattern. This practice will often yield a considerable saving and will be found satisfactory in advance of other methods. Frequently, we evade the trouble and expense of making a new pattern by selecting from standard patterns a bushing pattern approximating the required dimensions or easy to temporarily bring thereto.

The Nature of the Mold

The next consideration is the mold. In different instances it can be a green sand, skin-dried or a dry sand mold encased in a flask, or merely a dry sand core mold. Green sand will answer the purpose in the lighter classes of work, though faced and skin-dried or at least skin-dried, it will be found much more satisfactory. This skin-dried type of mold is representative of the best practice in all-around work with the exception of the duplicate type. When resorted to, however, the rod prints must be accorded maximum consideration since they support a heavy rod so heated as to reduce sand, in ordinary state, to powder. Two avenues of escape lie open. The prints and mold. The ends either can be given extra consideration in facing and drying or a solid dry sand print core can be made separately and rammed up with the pattern, the cores being understood to represent the half circle print, four cores being necessary to a single operation complete. This is the safer and more satisfactory method, since a solid dry sand core has many advantages over a mere skin-dried supporting surface. When the strictly green-sand mold is resorted to and no drying is attempted—and the thing is often done—it is a good plan to wet the prints well with weak molasses water and always accord the mold a thorough plumbago slicking, the protection of the sand against the heated rod being the object. When the bronzing rod is exceptionally heavy, another sterling practice is to lay cross-bars of iron across the prints of the pattern in ramming up the drag, thus affording the bronzing rod solid iron support.

Although a possibility, the dry-sand flask mold represents trouble and expense beyond its practicability. When the support of the flask to a core-mold is essential to its security, a flask or frame can be set around the core and green sand tamped solidly to support it. For all classes of duplicate work, warranting the initial expense, this dry sand core mold is the logical consideration. The initial expense is involved in the core boxes. They consist of a rectangular box, dimensioned so as to afford ample space and strength in the core and supplemented with removable inner parts, so shaped and placed, to accommodate resting position of the iron to be worked upon.

By a little study, much labor and material can be saved in making the core boxes and the number of parts thereby reduced to a minium. Thus, for reverse position of print in the core as affecting cope and drag halves, pin and pin holes can be figured out and placed so that the same individual core box piece can be made to serve both purposes. The same applies to the gate print, a removable piece which can be omitted in making the drag

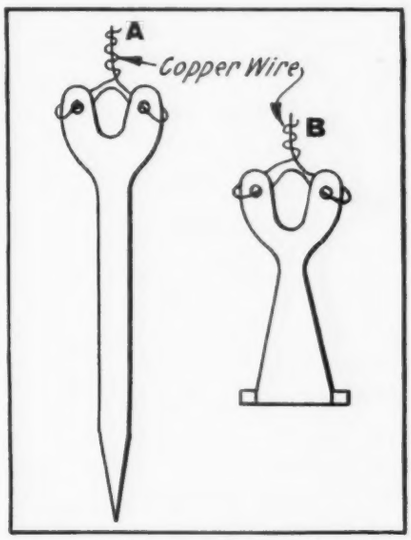


FIG. 4—HANDY FORMS OF ANCHORS FOR SECURING IRON RODS IN MOLDS

and supplied in manipulating the cope half. So marked are the possibilities along these lines, that in one class of work we make one box and three adjustable parts answer a purpose to which two boxes and six stationary parts otherwise would be required. In locomotive work these core molds will be found highly efficient and economical. In bronzing eccentrics, valve rods, valve rod guides, rocker arms, radius rods, eccentric straps, etc., they can be made to apply with unquestioned advantage.

The Unsupported Core

That the core, unsupported, admits probability of failure under its metal-enclosing pressure, is an unwarranted misgiving, an assumed difficulty readily dissolving in practice. If made reasonably heavy, rodded amply and of a good, strong core mix, little real danger of failure can exist. With surrounding core walls 1½ inches thick, we hold 75 pounds of metal safe under full gate pressure. A good core mix for this purpose consists of 12 parts of sharp sand, six parts of molding sand and one part of flour mixed with molasses water. Before pouring, the joints of the two halves should be rubbed together to insure close union. The core-mold then should be tightly clamped and all cracks and crevices securely pasted shut. A good mixture for this pasting material consists of five parts of molding sand, one part flour and one-half part pulverized fire clay mixed to consistency with molasses water. Such a mixture will readily dry by the heat of the iron it touches and holds until the seven hinges are burned away.

Gating the Mold

The gating of the mold represents another digression. The common method of providing a horizontal connecting gate with a perpendicular drop into the mold is not best suited to this purpose. The perpendicular alone is the better and gives hardest burning results by positioning its entrance directly over the iron core. Thus located, all the metal required to fill the mold drops directly on the iron and affects it more intensely. Instead of round, it should be flat and about 4 or 5 inches wide, paralleling the iron rod. In pouring, the pot or ladle should be accorded a gentle swinging motion in the same line in order to cover as much longitudinal iron surface as possible and thus increase the area of burning intensity. Taking a flow-off and coursing a quantity of metal through and out the mold before pouring is stopped, is a primary requisite to best results. The iron is thus heated hotter and more uniformly, the burn made more secure and the metal more placid in cooling. In bronzing long sections of rod, two pouring gates frequently are necessary. The pressure of solid metal along the route of running metal, however hot, has a decided tendency to freeze it. With a single pouring gate, the best position is near the one end with the flow-off at the opposite end. In double-pouring, the flow-off works best between the pouring gates. The pouring gate should be extended above the level of the flow-off to drive the metal through the mold and rapidly out of it.

The condition of the rod is another particular item. It is a part of logic that it must be scrupulously clean. Oxide film, rust, grease or any for-

cign substance on the iron surface will exert a wonderful protective influence against the molten bronze and will reduce the chances of a good burn-on. Further detrimental is the tendency of these impurities to agitate the metal, superinducing cavities and porosity. A rough burning surface is better than a polished one. Mechanical assistance can be derived from nicking this burning surface, or by filing or turning grooves in it. The rod should enter the mold in a heated state and the mold poured immediately thereafter. The heating fire should be clean and hot, admitting no carbon deposit and the last thing to be done before setting the rod in the mold is to make sure of its surface cleanliness. Any portion of the rod liable to be unintentionally affected by burning-on metal can be protected against it by coating with a mixture of lamp black and alchoholene, plumbago and alchoholene, or plumbago and common machine oil.

Bronzing Long Rods

In bronzing long sections of thin rods it is quite evident that under the intense heat their rigidity is lost admitting deflection, both dragward and copeward, the one by weight, the other by buoyancy. However inconsequential this buoyancy may be assumed to be, it nevertheless must be reckoned with. Especially is this true if the surface in question happens to be rectangular and of considerable length and width. Absolutely considered, in a perfectly liquid bath, buoyancy varies with the difference in specific gravity. Between average iron and the average copper-base alloy, this difference is one full point, which has a marked significance. Try to force to immersed position a 6-inch square iron plate in a pot of molten bronze and you will readily grasp the situation. In coming to final rest it is seldom, if ever, definite whether rod position will indicate no deflection, deflection upward or deflection downward. Personally, we have witnessed evidences of all three cases. It, therefore, is the part of wisdom to securely anchor, at regular intervals, long thin rods or strips in bronzing, and that against both directions of deflection. We once cast high grade bronze without anchoring on a long, thin iron rod centering that was intended for a gate valve stem. In machining, the iron was encountered near the longitudinal center of the stem shortly after the first roughing cut had been taken. A simple and efficient type of anchor for rod purpose is shown at *A*, Fig. 4. The pointed end is driven into the bottom board and the rod clamped to it by passing a single strand of copper wire through the side holes bringing the ends together at the top of the rod and twisting them to security.

It goes without saying that all positions should be accurately determined by trial and all preparations for final assembling should be made while the rod is cold and the mold thus prepared, guarded against accident of changing. All relative positions should be plainly marked on reciprocating parts and the final assembling should represent merely a duplicate of what had been faithfully gone over before. It sometimes happens that long, heavy rods are section-bronzed at or near the one end, necessitating an improvised *rest* for the opposite end of the rod. In all such cases the center line of the mold should be brought to a strict

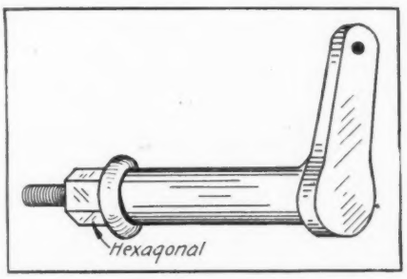


FIG. 5—A BRONZED, REVERSE FULCRUM ARM

level and the rod leveled up to it before any attempt is made at heating or completing. To guarantee results, the work of assembling and pouring must be definite, smooth and rapid, and if there is ever a time in a foundry when everything goes dead wrong, it is when you are forced to do something in a *P. D. Q.* manner and are not prepared so to do it.

Correct Pouring Temperature

The correct pouring temperature applying to such work is not altogether a one-sided affair. Naturally, the metal should be poured anything but cold, but then a temperature too great is logically possible. It is a fact of common experience that in most any type of brass foundry furnace, capability to raise the temperature of a copper-base alloy far above the melting point of iron is a demonstrated actuality. Pouring the metal at such temperature eats away an unreasonable amount of iron from the rod, impairing it and distributing isolated particles of the ferrous element throughout the surrounding nonferrous metal. In view of the fact that a goodly proportion of bronze-encased rods apply to bearing service, the importance of precaution against these conditions at once jumps into prominence. Nor should the metal be poured too cold. If so, first entering metal forms a thick, frozen crust around the iron through which crust all succeeding metal is all too impotent to penetrate and burn into the iron. There is a temperature, easier to identify than describe, and it is a correct one. It is that heat between white and yellow, that temperature that on an immersed and then shortly withdrawn iron skimmer shows a very thin crust of plastic metal into and through which countless beads of surface molten metal are rapidly penetrating and disappearing. It's the temperature that forms on your iron skimmers, that thin crust which in a cold and solid state you can by no manner of means separate distinctly from the skimmer, the temperature that reduces the surface of the iron to a plastic state without dissolving and carrying it away.

Bronzing a Pump Cylinder

Occasions sometimes arise when a thin-walled iron cylinder, such as a hydraulic pump piston, needs to be bronzed. In all such instances and similar cases, a part of the bronzing process is to fill the inner cavity with sand, not molding sand, but a good substantial core mix. Come to think about it, this core should be thoroughly dried right in the casing and well-vented before attempting to pour metal around its iron box. Incidentally, the center of the core should be hollowed out to accommodate contraction. This represents a class of bronzing, to or against the doing of which we always exercise careful deliberation. Instances frequently arise whereby far the safer, cheaper and more efficient plan is to cast a bushing separately, have it machined to a close, neat fit and then pin, sweat or braze it onto the iron, combining the three processes if necessary. Other things being equal, degree of expansion and contraction as between iron and bronze, favors iron. In rod-bronzing, however, bulk of material affected, intensity of temperature, rapidity in cooling and impotency in the resisting physical property, especially in the heated state, are all bronze-prepondering. Contraction is the opposite of expansion. If, in a band, a rod out-expand the band, the band tightens. If around a rod a band out-contracts the rod, the same result. At the limit of resistance—and as already stated, expansion and contraction operate practically independent of any such limit, outbounding furthermost limits—something has to give and it is always the material first transgressing its

own limit, which in the present instance is bronze. In a physical sense, contraction is the irresistable force, resistance of the iron to compression, the immovable body and the breaking point of the bronze to which contraction pays no heed, whatever, the limit of endurance. This means that you should never remove a bronzed rod from its mold until practically cold. If you do, increased radiation will intensify contraction in the bronze beyond the receding gait of the iron to accommodate and beyond the resistance of the bronze to withstand, with the probable result of a fracture occurring.

It must be remembered that a circle—a highly heated and endless form of material contracting around an unyielding solid—is a hard proposition to control. If you don't believe it, try to cast copper-base rings in an all-part iron mold with no *expanding-in-cooling* element in the mix. In great part the foregoing considerations apply to the strictly *burning-on* process and embody extremities in precaution not necessarily requisite to a merely bronze-encasing purpose and process. Suppose, for instance, a square or hexagon bar were to be bronze-encased for no very particular service. In such event, and were a mere mechanical setting satisfactory, a few grooves, filed or machine-turned, or several moderate sized holes drilled into the bar to prevent endwise slipping would subserve the purpose very well and reduce much particularity as requisite to the burning-on process. This feature is extensively observed in common practice, detecting its evidence in heating and breaking bronze encasements from cast iron centers in air brake equipment supplied by other foundries. This cast iron complement is cone-shaped and has end-flanges and circle grooves cast in it to mechanically prevent shifting of the casing. In the heated state, above a cherry red, a tap of the hammer sends the bronze casing flying in all directions, a thing impossible if it were burned onto the iron. Naturally, mere encasing is the much simpler process.

Alloy to be Used

Efficiency of the job varies perceptibly with the nature of the alloy used. It goes without saying that the higher-fusing alloys offer an advantage. High-lead metal is less favorable than others, regardless of fusing temperature. A clean, live metal, free from oxide, has much to be desired in burning-on property. Yellow brass, ordinary red brass, gun metal as per original or revised composition, all do well when properly manipulated, but if you want to get an adhesive equivalent to a cohesive union, use good phosphor bronze. You will find substantiating evidence in those cored castings where phosphor bronze penetrates the very wires of your cores and all but defies your efforts to chip it away. Before dismissing the manipulating feature of the discussion, it might be well to remark that if in a burning-on job a mold gives reasonable evidence of bad work, the best thing to do is to stop pouring, shake out the mold and get the bronze broke from the iron as quickly as possible. It may save you quite a bunch of trouble afterwards.

Efficiency is Impaired

We are convinced that burning bronze on iron or steel materially impairs the quality of this material and establishes a limit to its efficiency when this is done repeatedly. In illustration of this quality impairing tendency, we cite directly from experience: A large, 3-inch diameter main

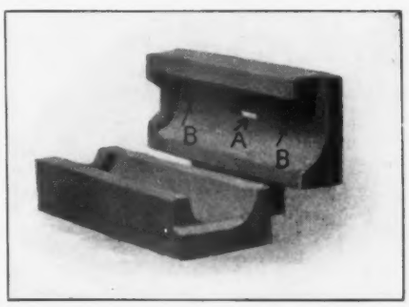


FIG. 6—CORES FOR BURNING-ON JOB ON A REVERSE FULCRUM ARM

driving wheel shaft on one of our molding machines became so worn in its two journal sections as to seriously interfere with efficiency in operation. We conceived the idea of taking a very slight cut in these two journal vicinities, burning-on with bronze to ½-inch thickness all around and having the machine shop turn down flush and then rebush the frame of the machine. This worked admirably, but required renewal about once a year, which more than paid for itself and, therefore, was an inconsiderate item after three rebronzings. One morning, with full power on and all belts traveling, the machine was thrown into gear but stood delierately still. It was simply a case of the pitcher going to the well once too often. The shaft had broken by torsion in the very center of the bearing. The fracture was clean and convincing of the impairing effect of the bronzing, exhibiting its evidence from circumference centerward. Though temporarily inconvenienced, we felt satisfied with the service it had given us, nor did we accuse it of laying down on the job without semblance of good reason.

Some features of this work are shown in the accompanying illustrations. Fig. 1 is a core mold with a stem ready for pouring, showing the flow-off and pouring gate. The stem as shaken-out of the core mold is illustrated in Fig. 2. For work of this type, so ample in draft, permanent molds could be used to advantage. Fig. 3 shows what happens when the iron rod is not properly anchored. It will be noted that it has been bent and forced to one side in the center. At *A*, Fig. 4, is a handy form of anchor for securing iron rods in molds. In green sand molds the anchor, *A*, can be pushed through the sand and tacked into the bottom board. In the core-molding process the base of the anchor, *B*, can be inset and pasted securely in the core. Fig. 5 is a view of a reverse fulcrum arm and Fig. 6 shows its bronzing cores. The longitudinal center slot, *A*, is the pouring gate and the end holes, *B*, are the flow-off gates. The same core box makes both halves, consisting in full of three parts. The center slot and end arm pieces are adjustable, while the flow-off holes are punched with a gate tube before drying the core.

Leaky Brass Castings

By Emil B. Horne

Every manufacturer of brass or bronze valves, in sizes up to 2 inches, as well as plumber's brass goods, has experienced heavy losses from leaky castings. When the biggest part of the machine work is completed on a casting it is taken to the test pump and often thrown out because it leaks. All foundrymen engaged in this line of work are more or less familiar with the causes assigned for this defect, such as pouring with metal that is too hot, uneven distribution of the metal, etc. For example, we will consider a faucet or valve that has heavy ribs, but rather thin walls and, as a rule, the leak will be found to be at the point where the ribs start. When the casting is poured, the thinnest part solidifies first, contracting at that spot, while the heavier parts are still liquid. This contraction takes more metal than there is at the thin spot and, therefore, it will draw away from the point where the metal is still in the liquid state. However, the heavy section solidifies at the same time, but since there is no more liquid metal upon which it can feed, it causes the grains to open produc-

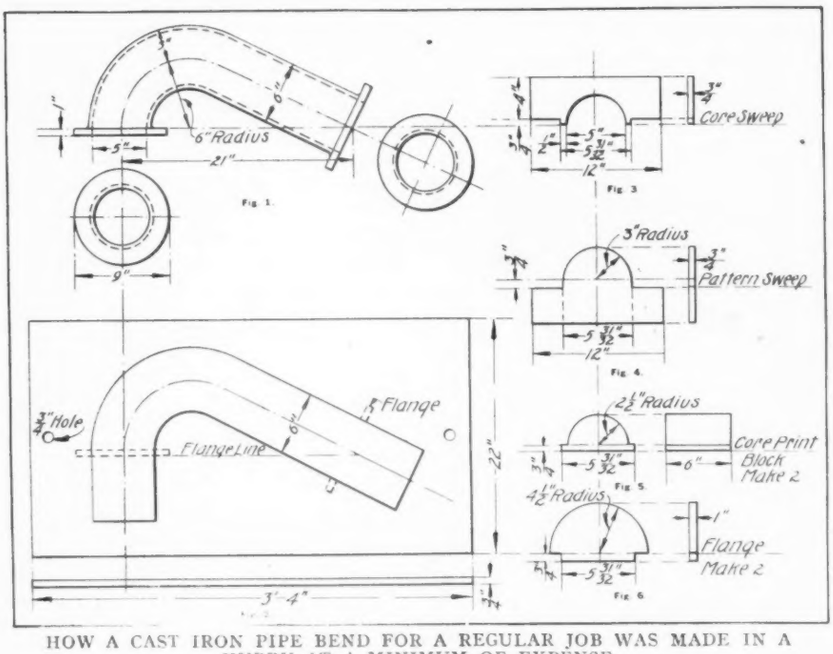
ing fine cracks which can be seen with a microscope.

It is altogether probable, also, that submerging faucets and valve castings in cold water at a high temperature may produce similar cracks when blowing out the cores, and while I am not certain that this is the cause of this defect, nevertheless the casting is subjected to a tremendous strain whenever there is no straight passage for an outlet for the suddenly evolved steam. Apparently sound castings frequently are blown to pieces when trying to blow out the core in this way. It might be argued that the cores must not be blown out of these castings while they are too hot and on the other hand, it might be stated that the cores will not readily leave a casting that is too cool. It is advisable, however, to use an open core with just sufficient binder to hold it together and to leave the casting in the molds a sufficient length of time to permit them to cool to a point where the metal will not be affected when submerged in water. Placing the castings with the cores into a drum with a few shovels full of small pebbles and directing a small stream of water on them will remove the cores and will prevent subjecting the castings to the sudden cooling when they are thrown into water. This will prevent any tendency toward crystallization. Under the microscope many of these blown castings show minute cracks due to forcing apart the grains of the metal when the cohesive power was not strong enough to overcome the pressure of steam evolved by blowing out the cores.

Making a Special Pipe Bend for a Hurry-Up Job

By John Koegle

Recently we received an order for a pipe bend for a repair job, the casting having to be delivered the following morning. No pattern being available, we were compelled to devise a simple method for making the mold as speedily as possible. A sketch of the pipe bend is shown in Fig. 1. The bend was laid out on a board, 3 feet 4 inches long, 22 inches wide and ¾ inch thick. The bend was laid out to the outside dimensions of the pipe, namely 6 inches, as shown in Fig. 2. It will be noted that the core length was added to the dimensons of the pipe. Openings were drilled in the board for flask pins and the board then was cut out to the lines with the band saw. A sweep, Fig. 3, next was made with projections as indicated. Another sweep, shown in Fig. 4, was made for making the mold. Two



HOW A CAST IRON PIPE BEND FOR A REGULAR JOB WAS MADE IN A HURRY AT A MINIMUM OF EXPENSE

core prints, Fig. 5, then were cut to fit the board, Fig. 2. Two flange pieces also were made, as shown in Fig. 6. This work, which was done by the band saw, required only two hours.

The board, Fig. 2, was laid on a straight core plate, and on this, half of the core was swept, after which the other half of the core was made. When dry, the two halves of the core were pasted together. The mold was made in an iron flask, the board shown in Fig. 2 having been mounted on a follow-board and the core print blocks, Fig. 5, and the flange pieces, Fig. 6, were set in the drag. The mold was swept with the sweep, Fig. 4, and after rolling-over, the flange pieces and the print blocks were removed, the board was lifted off and the drag was finished.

In making the cope half of the mold, the board, Fig. 2, was again placed on a follow-board and after setting the core print blocks and the flange ends, the risers and sprue sticks were set in position and the mold was rammed in the same manner as the drag, the cope having been swept with the sweep, Fig. 4. After setting the core in the drag, the mold was closed and the casting was delivered on time at a minimum expense for pattern work.

What You Will See at the Big Foundry Show

(*Continued from page* 348)

lifting coremaking machine and a motor-driven sand-mixing and compounding mill; represented by George H. Wadsworth, M. S. Sammons and Evan George.

WALLACE, J. D., Chicago.—A bench planer, equipped with flap and shutter safety guard, operated by a direct-connected electric motor from an electric light socket, will be displayed; represented by J. D. Wallace.

WARNER & SWASEY CO., Cleveland.—This machine tool exhibit will be operated and will consist of a universal, hollow hexagon, motor-driven turret lathe engaged on bar work and a universal, turret, motor-driven screw machine which will operate on chucking work; represented by Ralph Glaser.

WEST HAVEN MFG. CO., New Haven, Conn.—Hack saw blades, hack saw frames and a high speed motor-driven hack saw machine will be shown in two sizes, namely 6 and 9-inch. The hack saw machines will be operated; represented by F. S. Bradley and A. A. Twichell.

WHEELER & HOLCOMB, Chicago.—The safety exhibit to be made by this company will include fireproof gloves, mittens, leggings, aprons, pants, coats and other asbestos specialties; represented by F. H. Wheeler.

WHITE & BRO., INC., Philadelphia.—Ingot copper and composition brass ingots as well as castings made from these products will be displayed; represented by Raymond Hunter, George C. Proctor, Harold Reinhardt, and Frank Krug.

WHITING FOUNDRY EQUIPMENT CO., Harvey, Ill.—Photographs of the entire line of equipment for casting plants built by this company, will be displayed and enlarged views will be shown of the latest designs of cranes and foundry machinery; represented by C. A. Hardy, R. H. Bourne and G. E. Jones.

WOODISON, E. J., CO., Detroit.—A feature of this exhibit will be the new electric vibrator manufactured by this company as well as a clamp. Oil binders and a general line of foundry supplies also will be shown; represented by E. J. Woodison, George A. Burmam, W. J. Wark, Wm. Maybank, R. S. Hoffman, H. T. Taylor, A. F. Jordan and M. Werkman.

WOOD'S, T. B., SONS CO., Chambersburg, Pa.—Equipment for the system of taper snap molding, introduced by this company, including tapered snap flasks and automatic adjustable snap jackets will be exhibited. Both flasks and jackets will be shown in various sizes adapted to a wide range of snap work and specimens of castings made with this equipment also will be displayed; represented by Chas. O. Wood, Geo. M. Naylor and Victor Lesher.

Changes in the Foundry Industry Since 1914

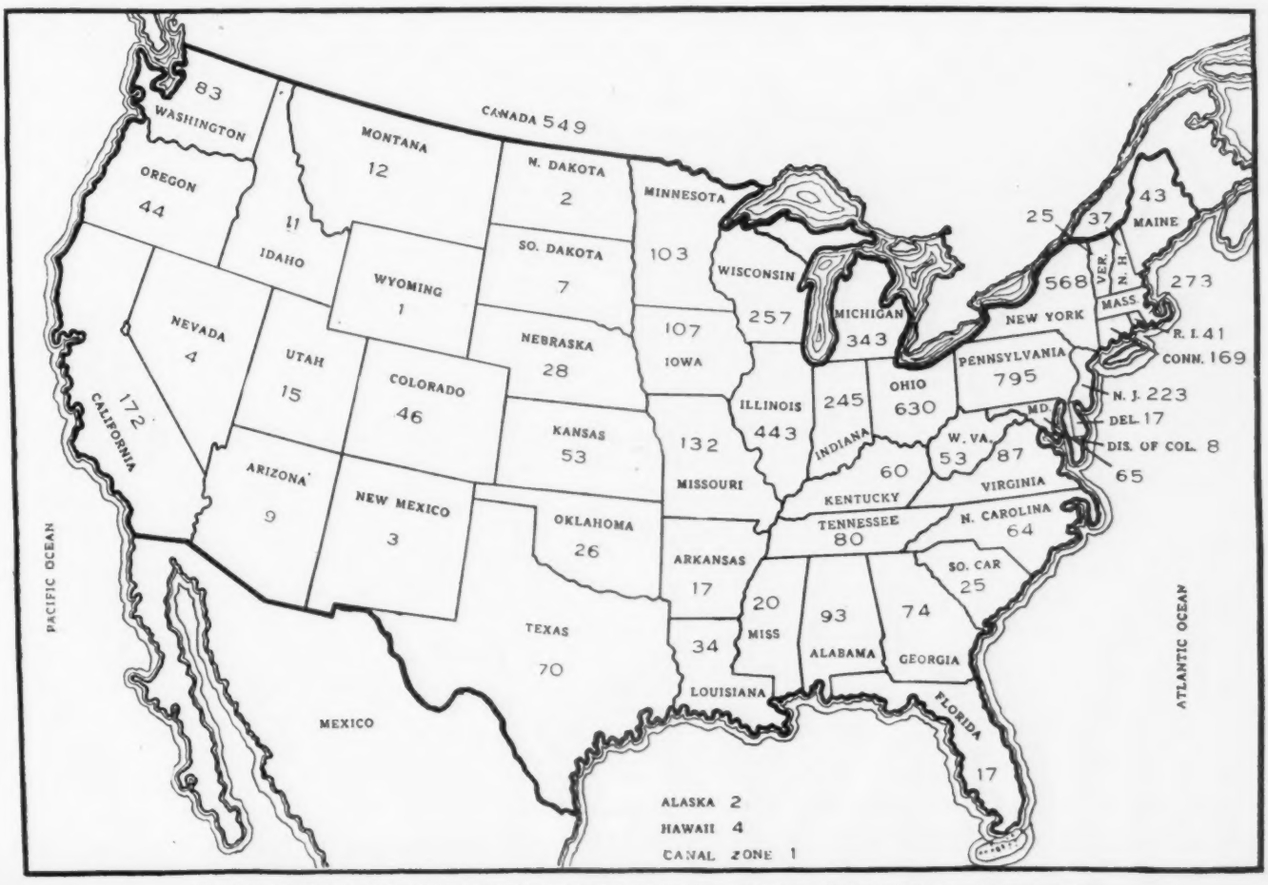
Statistics of the Casting Trade of the United States and Canada Show a Loss in Total Number of Plants, but an Increase in Steel and Aluminum Shops

STARTLING changes in the status of the American foundry industry are revealed by the statistics of the casting trade of the United States and Canada, recently compiled by THE FOUNDRY. On Sept. 15, 1914, there was a total of 6,507 shops devoted to the casting of metals on the North American continent exclusive of Mexico, but on Aug. 1, this year, this total had declined to 6,290, a loss of 217. Two years ago the United States had a total of 5,942 foundries, compared with 5,741 this year, a decline of 201. In 1914, Canada had 565 foundries, against 549 this year, representing a loss of 16. In large measure, this decrease is attributed to the trade depression which prevailed throughout 1914 and the first half of last year. Furthermore, plant concentration is another factor which had a potent influence on the elimination of the small shop and the plant employing two or three molders, taking off heats once or twice a week, is finding it increasingly difficult to compete with foundries of larger capacity.

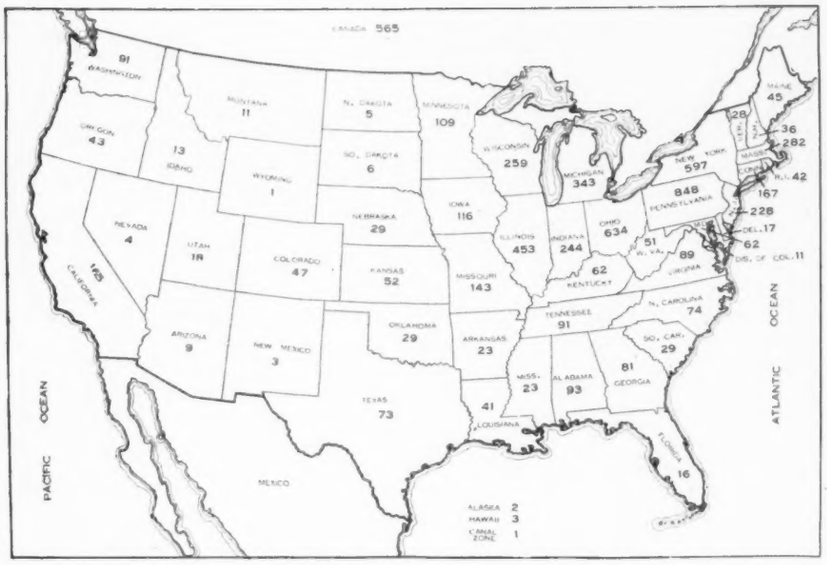
The mortality of the gray iron shops is surprising, the total decrease being 333 in a period of two years. In 1914, 5,057 plants in the United States and Canada manufactured gray iron castings, as compared with 4,724 this year. Two years ago the United States was credited with 4,574 shops devoted to gray iron manufacture, against 4,267 on Aug. 1. This represents a loss of 307 foundries in the United States and 26 in Canada, which now has only 457 gray iron foundries, as compared with 483 two years ago.

Decline in Number of Brass Foundries

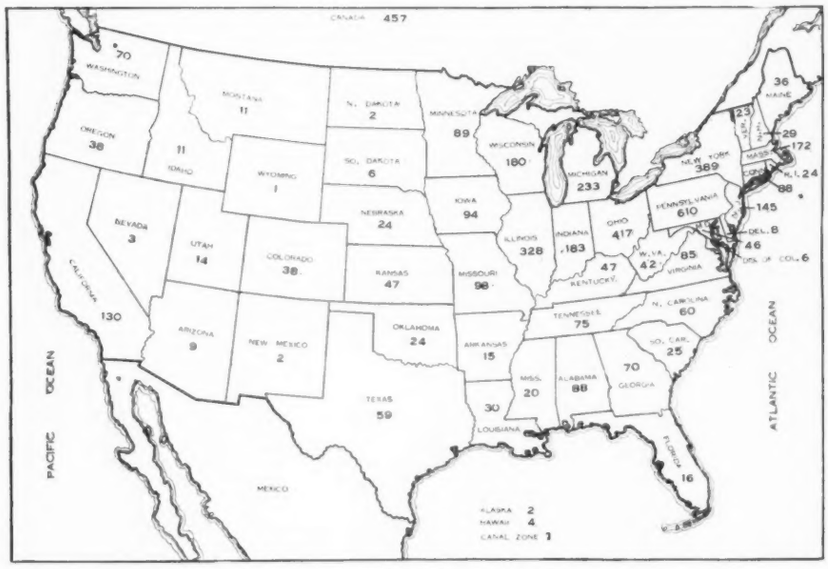
The next largest decrease is shown in the number of foundries melting brass and bronze exclusively. Two years ago the total of these shops in the United States and Canada was 1,266, compared with 1,223 on Aug. 1, a loss of 43. Canada, however, maintained her position fairly well in number of exclusive brass manufacturing plants, showing a loss of one only, against 42 for the United States. Canada now has 63 plants devoted exclusively to the production of brass castings, compared with 64 two years ago and the United States now has 1,160, against 1,202 in 1914. That the manufacturers of gray iron, malleable and steel castings do not consider brass departments profitable ventures, is indicated by the large decrease in the number of these small plants during the last two years. In 1914 the gray and malleable iron and steel foundries of the United States and Canada operated 2,566 brass departments in connection with their plants, against 2,224 this year, a loss of 342. The foundries of the United States now have a total of 1,979 brass departments as compared with 2,296 two years ago, a decline of 317, whereas Canada today has 245 against 270 in 1914, a loss of 25. The total exclusive brass foundries and non-ferrous metal departments of casting plants in the United States and Canada this year is 3,447, whereas two



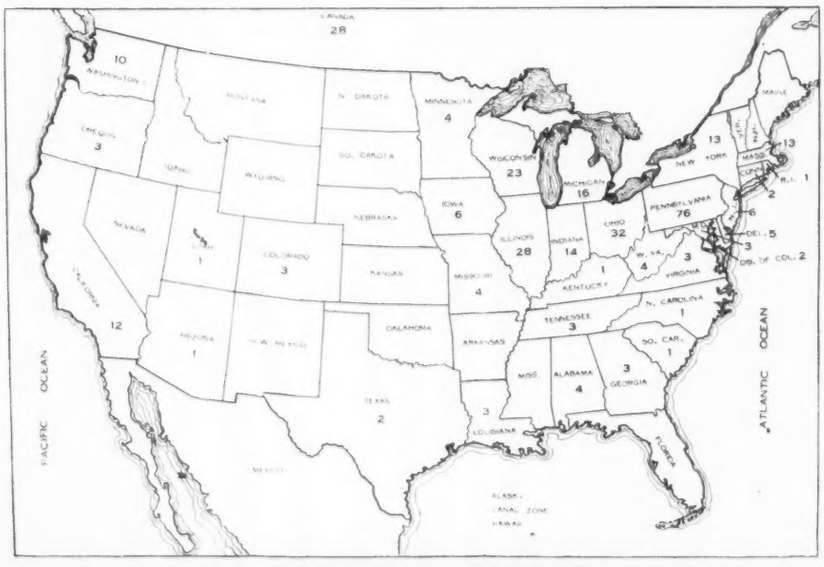
TOTAL NUMBER OF FOUNDRIES IN THE UNITED STATES AND CANADA, AUG. 1, 1916



TOTAL FOUNDRIES IN THE UNITED STATES AND CANADA, 1914



GRAY IRON FOUNDRIES IN THE UNITED STATES AND CANADA, AUG. 1, 1916



STEEL FOUNDRIES, UNITED STATES AND CANADA, 1916

years ago there was a total of 3,832 shops melting brass and bronze, a decrease of 385 in two years. The total exclusive brass foundries and brass departments of other casting plants in the United States today is 3,139, against 3,498 in 1914, representing a loss of 359, whereas Canada has 308 brass casting plants at present, against 334 two years ago, a loss of 26. It is evident that the difficulty of obtaining crucibles and the high prices prevailing for pots since the beginning of the war, has militated against the operation of such plants and, undoubtedly, the operator of many gray iron, steel and malleable foundries, with whom such departments were only of minor importance, have decided to discontinue the manufacture of brass and

Table I

TOTAL FOUNDRIES IN THE UNITED STATES AND CANADA, 1916 AND 1914.

United States and Canada, 1916	6,290
United States and Canada, 1914	6,507
Total foundries, loss	217
Foundries, United States, 1916	5,741
Foundries, United States, 1914	5,942
Loss in United States	201
Foundries, Canada, 1916	549
Foundries, Canada, 1914	565
Loss in Canada	16

GRAY IRON FOUNDRIES IN THE UNITED STATES AND CANADA, 1916 AND 1914.

United States and Canada, 1916	4,724
United States and Canada, 1914	5,057
Total gray iron decrease	333
Gray iron, United States, 1916	4,267
Gray iron, United States, 1914	4,574
Decrease in United States	307
Gray iron, Canada, 1916	457
Gray iron, Canada, 1914	483
Decrease in Canada	26

MALLEABLE FOUNDRIES IN THE UNITED STATES AND CANADA, 1916 AND 1914.

United States and Canada, 1916	213
United States and Canada, 1914	214
Decrease	1
United States, 1916	197
United States, 1914	196
Increase	1
Canada, 1916	16
Canada, 1914	18
Decrease	2

STEEL FOUNDRIES IN THE UNITED STATES AND CANADA, 1916 AND 1914.

United States and Canada, 1916	332
United States and Canada, 1914	318
Increase	14
United States, 1916	304
United States, 1914	299
Increase	5
Canada, 1916	28
Canada, 1914	19
Increase	9

bronze castings entirely and now are obtaining the supply for their own requirements from outside shops.

The large increase in the number of foundries melting aluminum is another surprising feature of these figures, since the total shops melting this white metal has shown an increase of 296 in two years. In 1914, 2,026 plants in the United States and Canada reported that they were melting aluminum, whereas this number has been increased to 2,322 today. Of the total increase, the United States is credited with 271 and Canada 25, this country now having 2,121 plants which melt aluminum as compared with 1,850 two years ago, while Canada has 201 against 176 in 1914. Al-

Table II

TOTAL OF EXCLUSIVE BRASS FOUNDRIES AND BRASS DEPARTMENTS OF OTHER PLANTS IN THE UNITED STATES AND CANADA, 1916 AND 1914.

United States and Canada, 1916.....	3,447
United States and Canada, 1914.....	3,832
Decrease	385
Total brass, United States, 1916.....	3,139
Total brass, United States, 1914.....	3,498
Decrease	359
Total brass, Canada, 1916.....	308
Total brass, Canada, 1914.....	334
Decrease	26

EXCLUSIVE BRASS FOUNDRIES IN THE UNITED STATES AND CANADA, 1916 AND 1914.

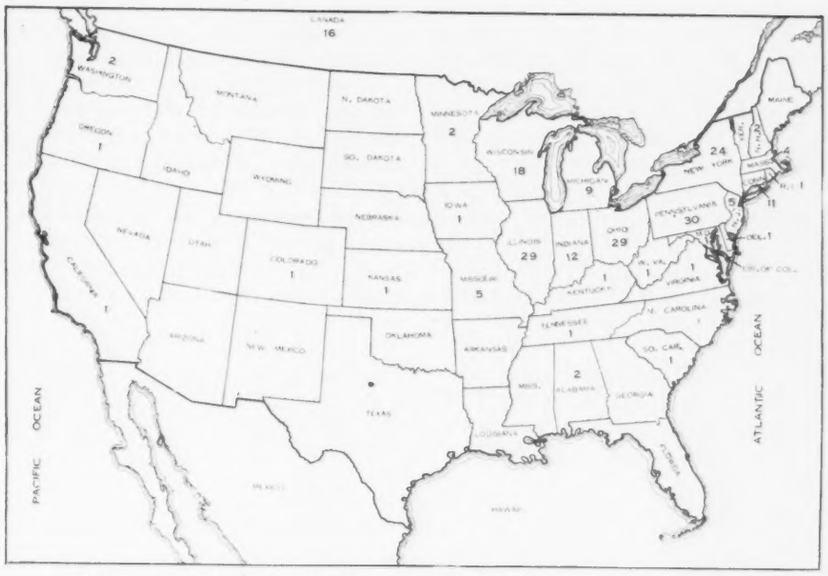
United States and Canada, 1916.....	1,223
United States and Canada, 1914.....	1,266
Decrease	43
Exclusive brass, United States, 1916.	1,160
Exclusive brass, United States, 1914.	1,202
Decrease	42
Exclusive brass, Canada, 1916.....	63
Exclusive brass, Canada, 1914.....	64
Decrease	1

BRASS DEPARTMENTS OF GRAY IRON, MALLEABLE AND STEEL FOUNDRIES IN THE UNITED STATES AND CANADA, 1916 AND 1914.

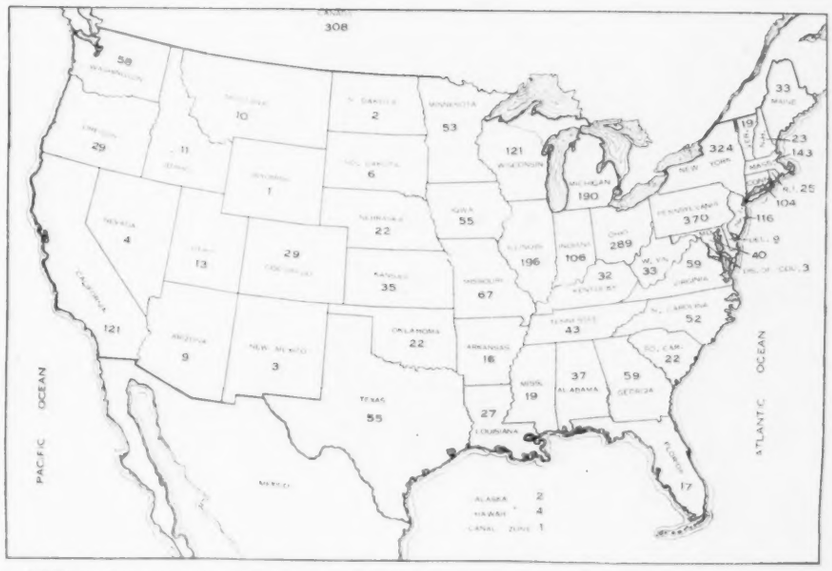
United States and Canada, 1916.....	2,224
United States and Canada, 1914.....	2,566
Decrease	342
Brass departments, United States, 1916	1,979
Brass departments, United States, 1914	2,296
Decrease	317
Brass departments, Canada, 1916....	245
Brass departments, Canada, 1914....	270
Decrease	25

FOUNDRIES MELTING ALUMINUM IN THE UNITED STATES AND CANADA, 1916 AND 1914.

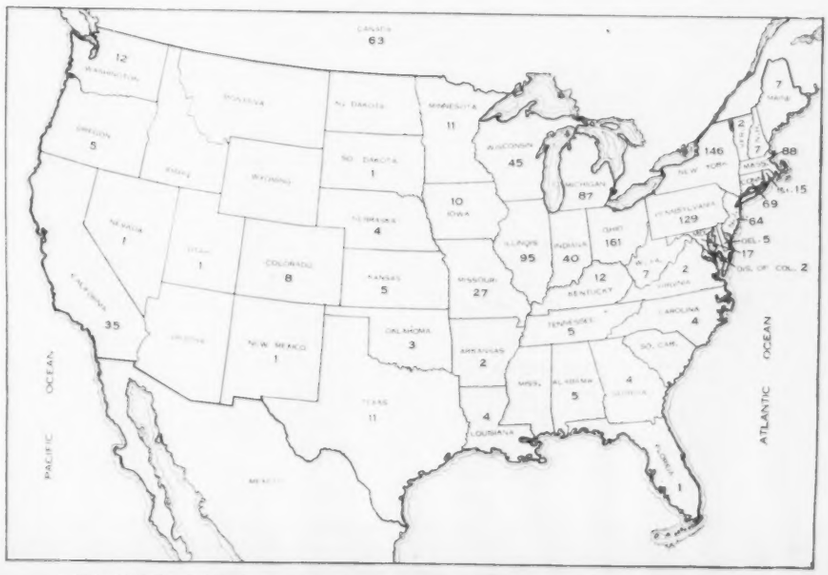
United States and Canada, 1916.....	2,322
United States and Canada, 1914.....	2,026
Increase	296
United States, 1916.....	2,121
United States, 1914.....	1,850
Increase	271
Canada, 1916	201
Canada, 1914	176
Increase	25



MALLEABLE IRON FOUNDRIES, UNITED STATES AND CANADA, 1916



TOTAL FOUNDRIES MELTING BRASS, UNITED STATES AND CANADA, 1916



EXCLUSIVE BRASS FOUNDRIES, UNITED STATES AND CANADA, 1916

though the requirements of the automobile trade have lead to the erection of many aluminum foundries, nevertheless this large increase, in a measure, must be assigned to the rapid development of the match-plate process for machine molding. Many plants that have adopted the aluminum match-plate process have installed small furnaces for making heats to meet their limited needs for match-plate work. It is evident, therefore, that the majority of plants represented by this increase are not commercial shops, but are melting aluminum solely for their own use. The tremendous increase in the price of aluminum, which amounts to about 300 per cent in a period of two years, evidently has had no deterrent effect upon the consumption of this metal, and notwithstanding some of the difficulty involved in melting and casting, its use is growing rapidly.

In view of the widespread installation of electric furnaces for melting steel for casting purposes, it was to be expected that the number of steel foundries would show an increase and the number of such shops has been added to by a total of 14 in the United States and Canada in the last two years. Exclusive of Mexico, there are 332 steel casting plants on the North American continent, against 318 in 1914, this country now having a total of 304 and Canada, 28. Two years ago there were 299 steel casting plants in the United States and 19 in Canada, the latter showing an increase of nine as compared with five for the United States. Since the beginning of the war, numerous plants have been erected in Canada for the

Table III

FOUNDRIES IN THE UNITED STATES AND CANADA BY STATES AND PROVINCES, 1916 AND 1914.

	Total foundries, 1916.	Total foundries, 1914.	Increase or decrease in two years.	Gray iron foundries, 1916.	Gray iron foundries, 1914.	Exclusive brass foundries, 1916.	Exclusive brass foundries, 1914.	Brass foundries departments of other shops, 1916.	Total brass foundries, 1916.	Malleable iron foundries, 1916.	Steel foundries, 1916.	Foundries melting aluminum, 1916.
United States:—												
Alabama	93	93	....	88	88	5	5	32	37	2	4	16
Alaska	2	2	....	2	2	..	..	2	2	..	..	1
Arizona	9	9	....	9	9	..	..	9	9	..	1	4
Arkansas	17	23	—6	15	22	2	1	14	16	..	..	10
California	172	165	+7	130	130	35	30	86	121	1	12	92
Canal Zone	1	1	....	1	1	..	..	1	1	..	1	1
Colorado	46	47	—1	38	40	8	7	21	29	1	3	20
Connecticut	169	167	+2	88	88	69	72	35	104	11	2	66
Delaware	17	17	....	8	10	5	3	4	9	1	5	4
Dist. of Columbia	8	11	—3	6	7	2	3	1	3	..	2	3
Florida	17	16	+1	16	14	1	2	16	17	..	..	13
Georgia	74	81	—7	70	76	4	5	55	59	..	3	34
Hawaii	4	3	+1	4	3	..	..	4	4	..	..	2
Idaho	11	13	—2	11	12	..	1	11	11	..	..	10
Illinois	443	453	—10	328	338	95	98	101	196	29	28	148
Indiana	245	244	+1	183	189	40	42	66	106	12	14	78
Iowa	107	116	—9	94	105	10	7	45	55	1	6	43
Kansas	53	52	+1	47	46	5	5	30	35	1	..	33
Kentucky	60	62	—2	47	51	12	11	20	32	1	1	18
Louisiana	34	41	—7	30	36	4	5	23	27	..	3	10
Maine	43	45	—2	36	38	7	7	26	33	..	..	17
Maryland	65	62	+3	46	45	17	17	23	40	1	3	23
Massachusetts	273	282	—9	172	177	88	95	55	143	4	13	102
Michigan	343	343	....	233	241	87	84	103	190	9	16	139
Minnesota	103	109	—6	89	94	11	12	42	53	2	4	44
Mississippi	20	23	—3	20	23	..	..	19	19	..	..	8
Missouri	132	143	—11	98	107	27	31	40	67	5	4	48
Montana	12	11	+1	11	9	..	2	10	10	..	..	7
Nebraska	28	29	—1	24	24	4	4	18	22	..	..	20
Nevada	4	4	....	3	3	1	1	3	4	..	..	1
New Hampshire	37	36	+1	29	29	7	7	16	23	2	..	18
New Jersey	223	228	—5	145	157	64	62	52	116	5	6	69
New Mexico	3	3	....	2	2	1	1	2	3	..	..	1
New York	568	597	—29	389	426	146	159	178	324	24	13	214
North Carolina	64	74	—10	60	66	4	8	48	52	..	1	39
North Dakota	2	5	—3	2	5	..	..	2	2	..	..	2
Ohio	630	634	—4	417	433	161	164	128	289	29	32	197
Oklahoma	26	29	—3	24	27	3	2	19	22	..	..	17
Oregon	44	43	+1	38	37	5	4	24	29	1	3	19
Pennsylvania	795	848	—53	610	652	129	141	241	370	30	76	223
Rhode Island	41	42	—1	24	24	15	16	10	25	1	1	17
South Carolina	25	29	—4	25	28	..	1	22	22	1	1	14
South Dakota	7	6	+1	6	6	1	..	5	6	..	..	3
Tennessee	80	91	—11	75	83	5	7	38	43	1	3	33
Texas	70	73	—3	59	61	11	12	44	55	..	2	39
Utah	15	18	—3	14	17	1	1	12	13	..	1	7
Vermont	25	28	—3	22	25	2	3	17	19	..	..	9
Virginia	87	89	—2	85	87	2	2	57	59	1	3	33
Washington	83	91	—8	70	79	12	11	46	58	2	10	45
West Virginia	53	51	+2	42	45	7	4	26	33	1	4	20
Wisconsin	257	259	—2	180	190	45	47	76	121	18	23	86
Wyoming	1	1	....	1	1	..	..	1	1	..	..	1
Total in United States	5,741	5,942	*—201	4,267	4,574	1,160	1,202	1,979	3,139	197	304	2,121
Canada:—												
Alberta	14	13	+1	10	10	4	3	9	13	..	2	10
British Columbia	23	21	+2	21	19	1	2	19	20	..	1	11
Manitoba	14	14	....	11	12	2	2	5	7	..	1	7
New Brunswick	20	23	—3	18	19	2	4	12	14	..	..	7
Newfoundland	2	2	....	1	1	1	1	..	1	..	..	..
Nova Scotia	35	33	+2	31	31	2	1	23	25	..	4	13
Ontario	327	341	—14	269	286	38	40	123	161	13	9	107
Prince Edward Island	2	3	—1	2	3	..	..	2	2	..	..	1
Quebec	105	109	—4	88	97	13	11	45	58	3	10	41
Saskatchewan	6	5	+1	6	5	..	..	6	6	..	..	4
St. Pierre Et. Miquelon	1	1	....	....	.....	..	..	1	1	..	1	..
Total in Canada	549	565	*—16	457	483	63	64	245	308	16	28	201
Total in U. S. and Canada	6,290	6,507	*—217	4,724	5,057	1,223	1,266	2,224	3,447	213	332	2,322

*Net decrease.

manufacture of steel for casting purposes, mainly for the manufacture of munitions. The mortality of steel casting plants during the past two years, however, was large although this is not to be compared with the number of gray iron foundries that passed out of existence during this period. Until about a year ago the prices prevailing for steel castings barely covered the cost of manufacture and in many cases higher prices were not obtainable until the first of this year. Also, the demand for steel castings shows a much larger proportionate increase than for gray iron sections, and to this fact is attributable the large number of new plants erected.

Malleable Iron Plants

Since 1914 the number of works engaged in the manufacture of malleable iron castings in the United States and Canada showed a loss of one, these countries now having 213 plants as compared with 214 two years ago. The United States now has 197 foundries devoted to the manufacture of malleable iron compared with 196 in 1914, whereas Canada only has 16 shops today against 18 two years ago.

While the malleable iron industry, based upon number of plants, shows a loss, nevertheless, the output today is almost double that of two years ago when the production was less than 40 per cent of the capacity. Difficulties in securing an adequate supply of labor now is curtailing the production considerably, which is estimated not to exceed more than 80 per cent of the possible output of the furnaces.

In the compilation of these figures each plant was considered as a unit regardless of the number of casting departments which it contains. All of the side-blow converter plants operate gray iron departments since the iron is melted in cupolas before it is charged into the steel-making vessels. Many of the malleable iron foundries also melt gray iron for making annealing boxes while the number of brass departments of gray iron, steel and malleable shops far exceed foundries that melt brass, bronze and aluminum exclusively.

The accompanying charts graphically show the distribution of the casting plants throughout the United States and Canada, while Table 1 contains the total number of foundries in the United States and Canada in 1916 and 1914; the gray iron foundries in 1916 and 1914; the number of malleable iron shops and steel foundries. Table II gives the total exclusive brass foundries and brass departments of other plants in the United States and Canada in 1916 and 1914, respectively, and also the number of exclusive brass foundries in these countries during these two years. The figures relating to the aluminum casting industry also are contained in this table. In Table III is given the total number of foundries by states and provinces. Pennsylvania again leads in total number of foundries, by a wide margin, being credited with 795 plants, but the loss in number of shops during the past two years far exceeds that of any other state. Two years ago Pennsylvania had 848 foundries and the decrease in two years is 53. Ohio again ranks second with 630 as compared with 634 two years ago, a loss of four. New York, which ranks third, has sustained a loss of 29 foundries since 1914, now being credited with 568 against 597 two years ago. California is the only state to show a substantial increase in number of casting plants. Two years ago there were 165 foundries in California as compared with 172 today, a gain of seven. Following New York, which is third, the other states rank as follows in number of casting shops: Illinois, 443, a loss of 10 since 1914; Michigan, 343, the same number as two years ago; Massachusetts, 273, a loss of nine; Wisconsin, 257, a loss of two; Indiana, 245, a gain of one; New Jersey, 223, a loss of five; California, 172, a gain of seven, and Connecticut, 169, a gain of two. In Canada, the province of Ontario takes first rank, with a total of 327 foundries against 341 in 1914, a loss of 14, and Quebec is second with 105, compared with 109 two years ago, a loss of four.

Table IV

LEADING FOUNDRY CENTERS OF THE UNITED STATES AND CANADA

	Total foundries, 1916.	Total foundries, 1914.
Chicago	170	170
New York City	115	116
Cleveland	112	104
Philadelphia	106	121
Detroit	103	99
Pittsburgh	71	70
Milwaukee	69	71
Cincinnati	69	63
Buffalo	68	67
St. Louis	63	64
Toronto, Ont.	51	48
Boston	49	53
Newark	45	43
San Francisco	43	38
Baltimore	40	39
Minneapolis	35	35
Indianapolis	35	34
Louisville	33	31
Dayton	33	28
Erie	30	30
Rochester	30	28
Montreal	29	28
Birmingham	29	26
Toledo	29	26
Chattanooga	25	28
Reading	25	25
Jersey City	24	23
Bridgeport, Conn.	24	23
Seattle	23	21
Kansas City	22	22
Worcester, Mass.	20	22
Providence, R. I.	20	21
Portland, Ore.	20	19
Hamilton, Ont.	19	18
Racine, Wis.	19	17
Atlanta	17	20
New Haven	15	15

Chicago again takes first rank among the leading foundry centers of the United States and Canada, with New York City second, Cleveland third, Philadelphia fourth, Detroit fifth, Pittsburgh sixth, Milwaukee and Cincinnati tied for seventh, Buffalo eighth, St. Louis ninth, and Toronto tenth. Two years ago Philadelphia ranked second, but owing to a loss of 15 shops, mainly small brass foundries, New York has been given the runner-up position, with Cleveland third, the latter city having advanced from fourth place two years ago.

Leading Foundry Centers

Chicago has 170 foundries, the same number as in 1914; New York City 115, against 116 in 1914, while Cleveland, with a total of 112, shows a gain of eight shops in four years; Philadelphia has 106 foundries compared with 121 in 1914, showing a loss of 15 plants; Detroit has gained four and now has 103; Pittsburgh has 71, a gain of one; Milwaukee 69, having lost two; Cincinnati 69, having gained six; Buffalo 68, having gained one; St. Louis 63, having lost one; Toronto 51, having gained three, and Boston 49, having lost four in a period of two years; San Francisco has gained five shops, now having a total of 43, while Dayton, with only 28 casting plants two years ago, now has 33. The leading foundry centers in the United States and Canada, arranged according to rank on Aug. 1, this year, are given in Table IV.

Porosity of Gray Iron Castings

By W. J. Keep

Question:—We are having trouble with gray iron pump runners subjected to alkaline water. The runners are about 4½ feet in diameter with eight vanes. The trouble occurs where the vanes join the main part of the casting. The difficulty, which is due to porosity, apparently is not caused by shrinkage. The iron is ½ to ⅝-inch thick in the vanes. The only place where it is any thicker is at the hub. The trouble may have been caused by electrolysis. What analysis of iron would you recommend for a casting of this nature?

Answer:—It is probable that your difficulties are attributable to porosity arising from shrinkage, and an effort should be made to overcome this. First, all parts of the casting should be made a uniform thickness. At the points where the vanes join the main casting, even if both were of the same thickness, the iron would have a tendency to be porous at the junction. The use of chills in the mold,

set against the parts which are porous, will cause the iron to set quickly at these points, overcoming porosity. Also, a mixture can be used, low in silicon and carbon, which still should give you sufficient softness to enable you to machine the casting. The phosphorus and sulphur also should be maintained at a very low percentage, and the manganese should be about 0.5 per cent. Remarkable results in overcoming porosity are obtained by the use of cast iron borings charged in the cupola in boxes made of boards, 1 inch thick, with covers nailed on. Each box should contain a charge of 100 pounds and this should be figured in the mixture the same as 100 pounds of iron. We would suggest that you first try one box of borings to each 1,900 pounds of other iron, and subsequently two boxes to each 1,800 pounds of iron.

Only the Carroll Steel Foundry Purchased

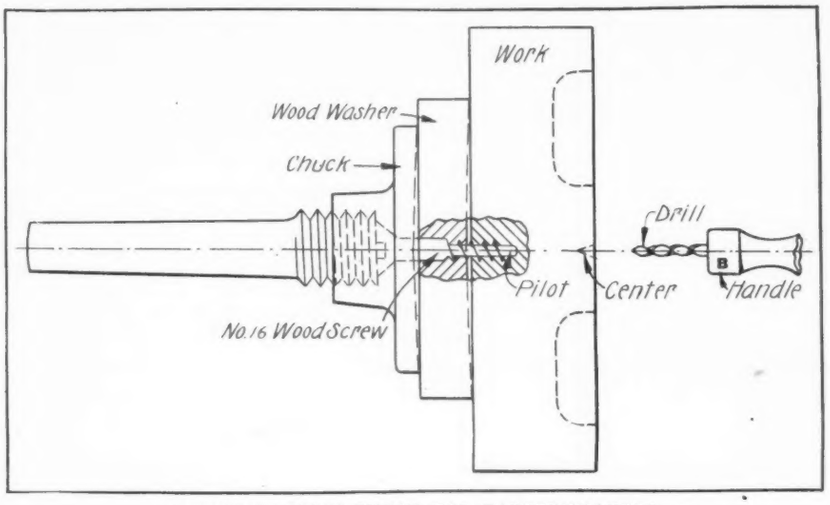
In the article published in the August number of THE FOUNDRY, describing the plant of the Ohio Steel Foundry Co., Lima, O., it was stated that it had purchased the plant of the Carroll Foundry & Machine Co., Bucyrus, O.. This purchase, however, involved only the steel casting department of the Carroll Foundry & Machine Co., which is still operating its machine, boiler and pattern shops, gray iron foundry, etc.

Chas. Pascoe, formerly metallurgist for the Canadian Steel Foundries, Ltd., and recently connected with the Thos. Davidson Mfg. Co., Ltd., Montreal, in the capacity of consulting metallurgist now is affiliated with the Snyder Electric Furnace Co., Chicago, as metallurgist in the company's electric furnace research plant at Clearing, Ill.

A Screw Chuck for Patternmakers

By M. E. Duggan

In the accompanying illustration is shown a screw chuck for patternmakers. While it is not new, nevertheless it embodies a few improvements in the construction of the chuck and my method of chucking and reverse chucking work that is to be turned in a patternmaker's lathe, simplifies this operation and reduces the time required to do the work. The chuck is standard equipment, but the improved chuck is my personal property. The face of the chuck is slightly concave, as shown by the dotted lines, the screw being inserted with a driving fit into the hole in the center of the chuck and projects beyond the face of the chuck about 1 inch instead of having a gimlet point. The screw has a pilot on the end. I never use anything smaller than a No. 16 screw and never drive or force a screw into a piece of work. A hole is drilled in the piece that is to be turned, and for this purpose two drills are employed which have the same diameter as the pilot on the end of the screw. One of these I use in the brace and the other is fastened in a wooden handle, as shown by the small sketch. When turning thin stock I use a washer made of seasoned maple wood, three of these being provided for convenience, namely, ¼, ⅜ and ½-inch in thickness.



A HANDY SCREW CHUCK FOR PATTERNMAKERS

My method of reverse chucking is best explained by citing an example of everyday work. In the illustration is shown a blank pattern for a cut gear, 8 inches in diameter, 2 inches face and recessed on both sides as shown by the dotted lines. This leaves a web in the center, ⅜-inch thick, and after sawing the piece that is to be turned, I drill a hole with a brace drill about ¾-inch deep for the screw. For this job I use a ⅜-inch washer between the work and the chuck, thus allowing about ⅝-inch of the screw to enter the piece that is to be turned. The piece is fastened in the chuck and the diameter, face and recess are turned and finished. Before removing the piece from the chuck, a hole is drilled in the center which is first countersunk to guide the drill. To insure accuracy, I use the pointed center of the tailstock without turning the tool and by grasping the handled drill firmly and by pressing the drill into the countersunk opening, the hole is made. Next, the chuck is reversed. The pilot will follow the hole and guide the screw into the wood, the concave face of the chuck and the washer when used, keeping the piece from rocking. The hole causes the screw to make a perfect thread in the wood and the base will never split nor work loose if only ½-inch of the screw is in the wood. By this method I can reverse-chuck a piece in less than a minute, which otherwise would require one-half hour.

Gas and Flame at the Charging Door

By W. J. Keep

Question:—Until recently we have never experienced any great amount of difficulty in the operation of our cupola. However, for several weeks the gases have been flaming out of the charging door and the heat is so intense that the men on the charging platform are compelled to stand away from the door when making the charges. Therefore, the charging is not done uniformly. The cupola is lined to 75 inches and we use both sets of tuyeres with a blast pressure of from 16 to 18 ounces when starting the heat. The charging doors are 16 feet from the bottom. The bed extends to a height of 18 inches above the upper tuyeres, on which we charge 5,200 pounds of iron and the successive coke charges are 475 pounds each.

Answer:—Your trouble can be attributed to the quality of coke which you are using, which has not been burned long enough in the coking operation. The analyses of any two cars of coke may seem the same, but only 0.5 per cent increase in volatile matter in one grade of coke over another will cause trouble. If you will present your case to the concern furnishing you with coke, it undoubtedly will receive attention and you probably will obtain a consignment of fuel that has been burned 72 hours.

W. B. White has resigned as superintendent of foundries of the Stanley G. Flagg Co., Stowe, Pa., to accept the position of factory superintendent of the National Sanitary Mfg. Co., Salem, O. Mr. White enters upon his new duties, Sept. 1.

How To Build Your New Foundry Economically

by EL SHANER

SCARCELY more than a year ago, when the quickening pulse of business activity was beginning to be felt throughout the country, foundrymen were rudely brought face to face with an unprecedented situation. They discovered that their resources, which during a period of several decades had been sufficient to meet the requirements imposed by each succeeding wave of prosperity, were inadequate to handle the vast number of orders suddenly thrust upon them. The proprietors of foundries hesitated at first to invest in additional facilities for what appeared to be an uncertain future, but as the stamp of permanency began to be associated with the amazing demand for castings, a strong impetus was given to the erection of new foundry buildings and to additions to existing plants. The many structures which sprang up all over the country as a result of this condition and the numerous plants built as part of a healthy expansion dating back to times when business was normal, have distinguished the present building era as the greatest in the history of the foundry industry.

A study of the buildings now being erected discloses the interesting fact that foundrymen are paying more attention than ever before to the arrangement and details of the structures which house their business. Instead of erecting a group of buildings without considering the uses to which they are to be put, as was the practice in the early days of foundry history, proprietors are now arranging each feature of their new plants with a view to facilitating manufacturing operations. They are rapidly accepting the principles long advocated by efficiency engineers who tried to show that the factory must be built to suit the business, and that the business that is crammed into a poorly designed plant cannot possibly be conducted efficiently. The large number of foundries operating at comparatively low capacity, under burdens of overhead expense out of all proportion to the output, bear mute testimony to the fallacy of the obsolete, short-sighted or niggardly building policy.

As a result of this changed viewpoint, we find that foundrymen are no longer planning their new plants according to the narrow-minded ideas fostered by traditions of long standing. Foundry buildings of today show none of the glaring inconsistencies of the nineteenth century. Veritable fire traps of wood are no

FIG. 1—MODERN TYPE OF FOUNDRY BUILDING. THE WALLS ARE BRICK WITH CONTINUOUS SASH. SIMPLE STRUCTURAL STEEL FRAME WORK AND SMOOTH CEILING FACILITATES CLEANING AND PAINTING

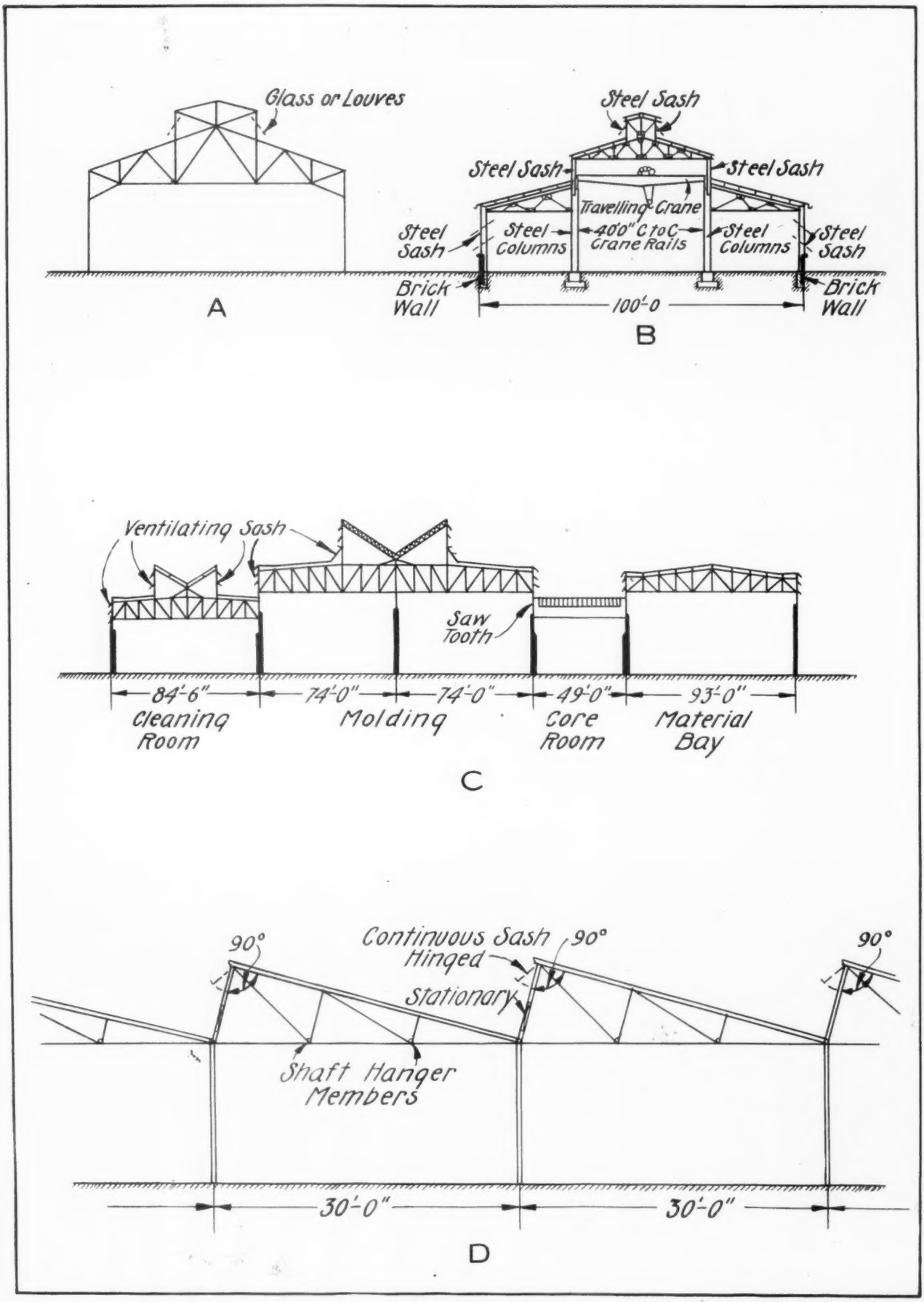


FIG. 2—FOUR ROOF TRUSSES IN GENERAL USE IN MODERN FOUNDRY CONSTRUCTION

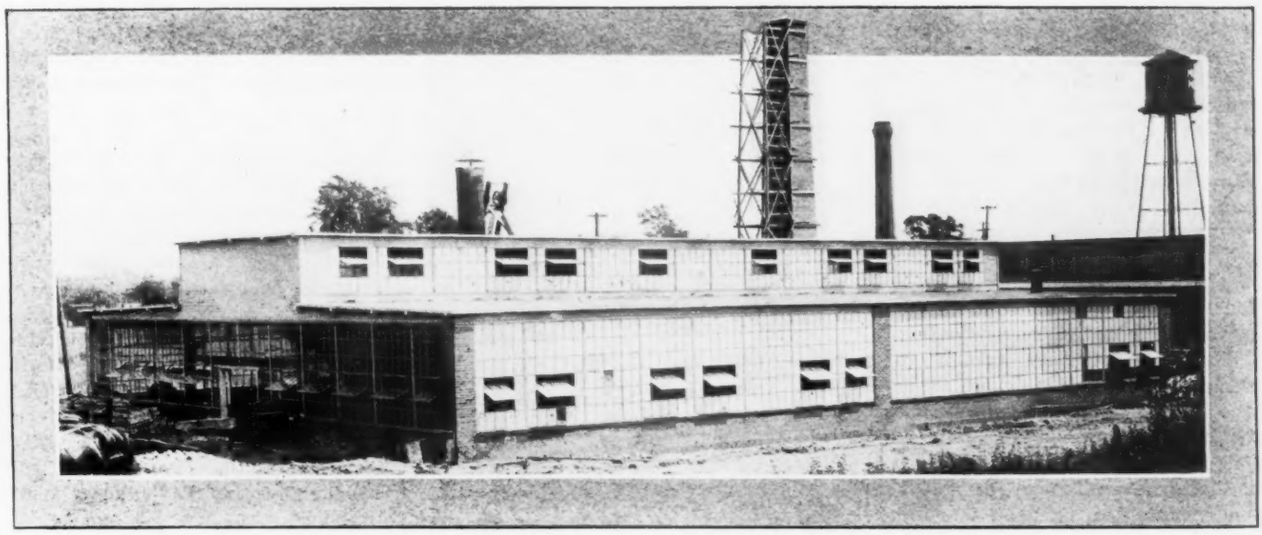


FIG. 3—EXTERIOR VIEW OF TYPICAL SMALL FOUNDRY BUILDING, SHOWING ARRANGEMENT OF WINDOWS AND VENTILATORS

longer tolerated; inadequate lighting has been recognized as a mistake of the past; poor ventilation is fast giving way to improved conditions; and sanitation and safety, factors unheard of even a few years ago, are now given most careful attention.

Foundry managers have been slow to grasp the importance of expending time and money in the achievement of ideal working conditions through the proper planning of new buildings, but the effect of the new idea upon the operation of the foundry is fast winning converts. With orders piling up at an unforeseen rate, and with raw materials selling at tip top prices, the shop manager realizes the necessity of economy, and he now appreciates the fact that rattle-trap buildings are not economical. Moreover, he is alarmed at the restlessness of foundry labor. Statistics tell him that the annual turnover of labor in the average casting plant exceeds that of any other industry, and he is forced to admit that any effort he can make to better satisfy his workmen will result in fewer strikes, less hiring and firing, and ultimately less indirect operating expense. For these reasons, the builder of a modern foundry gives much thought to the problem of obtaining the best working conditions economically.

Before going into the details of building construction it is well to consider the problem from the standpoint of the industrial engineer. Charles Day, in *Industrial Plants*, classifies the work incident to the planning and building of manufacturing establishments in an unusually clear and practical manner. Without understating the importance of properly financing a new building project, or the extreme necessity of carefully selecting the building site, Mr. Day lays especial stress upon the subject of factory planning. Careful consideration of the requirements of the contemplated business, he maintains, will insure a more orderly plant and will lower production costs.

In planning a new foundry for Dodge Bros., Detroit, the architects put into actual practice the principles advocated by Mr. Day and other industrial engineers. Before the plans for the new

FIG. 4—INTERIOR VIEW OF BUILDING SHOWN IN FIG. 3. NOTE THE EVEN DISTRIBUTION OF LIGHT ADMITTED THROUGH THE SIDE WALLS OF THE MONITOR

buildings were drawn, the architects were furnished with information covering every pattern, and from this as a basis, data were compiled representing every operation involved in the production of castings at a predetermined rate. The details of these preliminary data were published in the June, 1916, issue of THE FOUNDRY. Although the requirements of average castings plants do not necessitate the intricate estimating involved in planning the Dodge foundry, it should be remembered that the architect or engineer who lays out the plant must have certain fundamental data to guide him, if the buildings are to satisfactorily accommodate the contemplated business. Unless the foundry manager is absolutely sure that he has made provision for all of the contingencies bearing upon the intended method of operating the plant, he should allow an engineer to check his recommendations. Failure to do this has been responsible for expensive alterations which have had to be made to correct omissions and errors of "I-know-it-all" foundrymen.

Having carefully estimated the kind and amount of equipment needed in the new foundry, the next task is to arrange it in such a way that the work will progress through the various processes of manufacture in a straightforward manner. In large casting plants this is a complicated problem and requires the attention of experts in foundry practice. Many men have simplified the task of arranging the equipment by constructing a rough model of the proposed buildings and then changing the position of the various machines, furnaces, etc., until a satisfactory arrangement has been found. It is poor practice to plan a foundry on the assumption that the machines and apparatus may be located after the buildings are completed. The man who is short-sighted in this regard will meet all kinds of trouble when he tries to put his plant in operation.

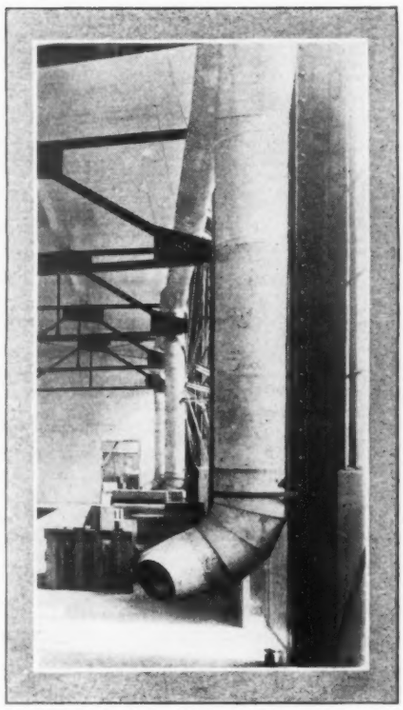


FIG. 5—ONE METHOD OF ARRANGING HEATING PIPES NEAR LOWER WALLS OF FOUNDRY TO WARM FRESH AIR ADMITTED THROUGH LOWER VENTILATING SASH

Modern foundries may be classified according to the general arrangement of the various departments, and in most cases this is largely governed by the size of the building site or the comparative weight or size of the castings produced. In congested districts, where land values are high, foundries of the multi-story type are built, providing the castings to be made are not of excessive weight. Many foundries operated in connection with plants manufacturing automobiles, stoves, sewing machines, electrical machinery, and other articles in which small castings are used, present examples of the multiple-story arrangement. In outlying districts the area of the building site is not as limited as in a city, and consequently the foundry buildings are generally of the one-story type. Plants where heavy machine and engine castings are made are typical of this arrangement. Sometimes conditions are such that it is advisable to use a combination of the two schemes, and in foundries constructed according to this plan, the main building housing the cupolas, molding floors, cleaning rooms, etc., is of the one-story type, while the pattern shop, pattern store rooms, drafting rooms and offices occupy a multiple story building.

By far the most of the foundries in this country are built according to the single-story plan which allows the greatest flexibility in laying out the various departments. One-story buildings present less fire hazard than multi-

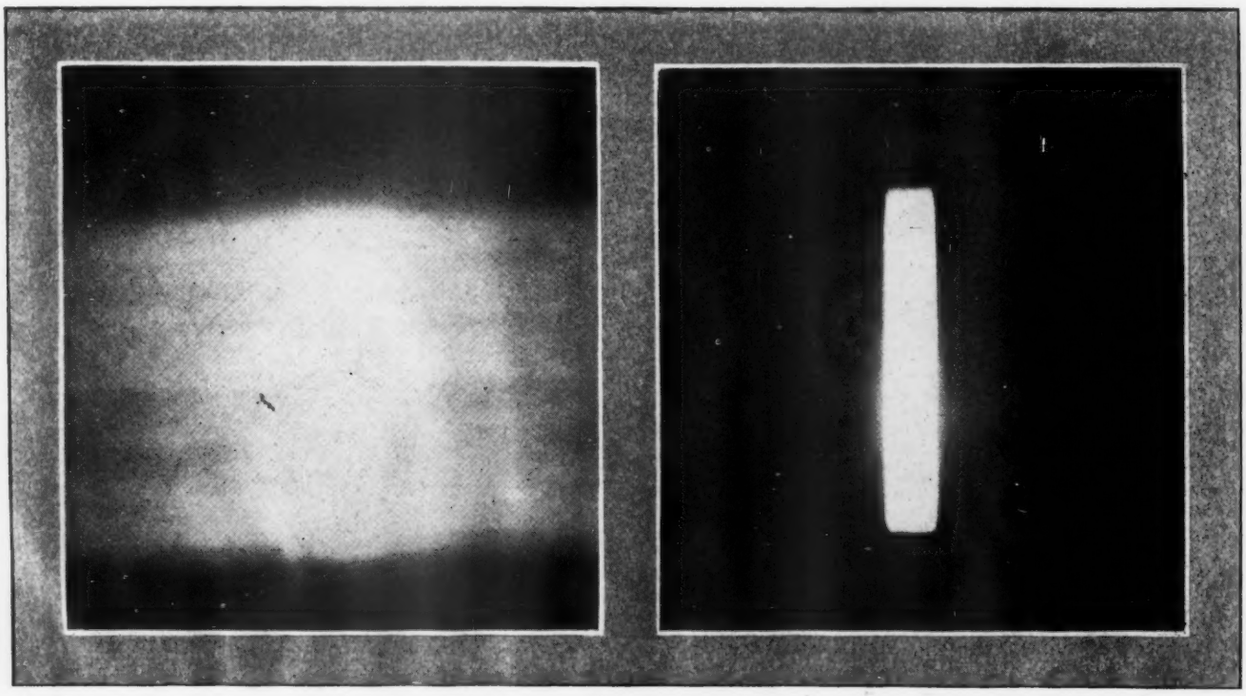


FIG. 6—TWO VIEWS SHOWING QUALITY OF LIGHT ADMITTED THROUGH PLAIN AND RIBBED GLASS
Note that the light entering through the ribbed glass is diffused over a much greater area than that admitted by the clear glass.

ple-story buildings, afford the best natural lighting, eliminate the isolation of departments and permit expansion to the boundaries of the property at a minimum expense.

Most of the buildings of this type now being erected for foundry purposes are of steel frame construction. Several common types of roof trusses that are in general use are shown in Fig. 2. The truss shown at *A* is one of the simplest used in foundry construction. The type illustrated at *B* is adapted to shops in which heavy castings are made and where large capacity cranes, requiring considerable headroom, must be installed. The two side bays are usually devoted to the departments dependent upon the molding operations, as the core room, sand bins, cleaning department, etc. The arrangement shown at *C* is one that is particularly recommended for foundries on account of the peculiar roof construction, which is said to provide for unusually good ventilation and natural lighting. This construction, however, is more expensive than that shown at *A* and *B*, consequently it is not used so generally. The saw-tooth roof, *D*, is particularly adapted to single-story buildings covering a large area. Very few foundries using the saw-tooth construction exclusively are to be found, but there are many in which a combination of types *A* or *B* and *D* is used. The truss shown at *B* is used more extensively than any other, and for that reason, the details of construction mentioned in the following paragraphs have been selected with a view to their adaptability to that particular type of construction. As a matter of fact, however, the materials of construction for the various forms of single-story buildings do not vary to any great extent.

Concrete has practically supplanted all other materials for foundations for walls and machines. As a rule, building foundations for foundries do not extend far above the normal level of the ground, and since this does not necessitate a smooth finish, rough concrete mixed according to standard specifications is a satisfactory material. In some cases, when the foundations are exposed for some distance above the ground, brick is preferable. The difference in the cost of brick and concrete is not great, and for this reason concrete is usually the more economical because of the ease with which it is put in place. In a foundry in which jolt-ramming molding machines are to be used, it is well to make ample provision for their foundations, so that the floor of the molding department will not have to be torn up at the time the equipment is being installed. The arrangement ad-

Table I

ANALYSIS OF COST OF LIGHTING

	Size of lamps, rated watts.								
	Mazda, 40 Watt	Mazda, 60 Watt	Mazda, 100 Watt	Mazda, 200 Watt	Mazda, 300 Watt	Mazda, 400 Watt	Mazda, 500 Watt	Mazda, 750 Watt	Mazda, 1000 Watt
Cost of lamp, list.....	$0.270	$0.360	$1.000	$2.000	$3.000	$4.000	$4.500	$6.000	$7.000
Cost of lamp, disc*....	0.243	0.324	0.900	1.800	2.700	3.600	4.050	5.400	6.300
Cost of reflector, disc*.	0.641	0.736	0.862	1.114	3.371	3.371	3.371	3.875	3.875
Cost of unit, disc*.....	0.884	1.060	1.762	2.914	6.071	6.971	7.421	9.275	10.175
Annual fixed charges:—									
Interest on total investment, 6 per cent.	$0.053	$0.064	$0.106	$0.175	$0.364	$0.418	$0.445	$0.557	$ 0.611
Depreciation on reflector, 12½ per cent..	0.080	0.092	0.108	0.139	0.421	0.421	0.421	0.484	0.484
Labor, monthly clean'g.	0.240	0.240	0.240	0.360	0.360	0.480	0.480	0.480	0.480
Total	$0.373	$0.396	$0.454	$0.674	$1.145	$1.319	$1.346	$1.521	$ 1.575
Maintenance cost per 1,000 hours:—									
Lamp renewals, disc*.	$0.243	$0.324	$0.900	$1.800	$2.700	$3.600	$4.050	$5.400	$ 6.300
Energy cost per 1,000 hours at 1c per kw-hr.	$0.400	$0.600	$1.000	$2.000	$3.000	$4.000	$5.000	$7.500	$10.000

*Discount allowed on purchase of certain quantity of equipment.

FIG. 7—AN INTERIOR VIEW OF A TYPICAL FOUNDRY FOR HEAVY WORK. NOTE THE HEAVY STRUCTURAL DETAILS REQUIRED TO SUPPORT THE CRANE RUNWAYS

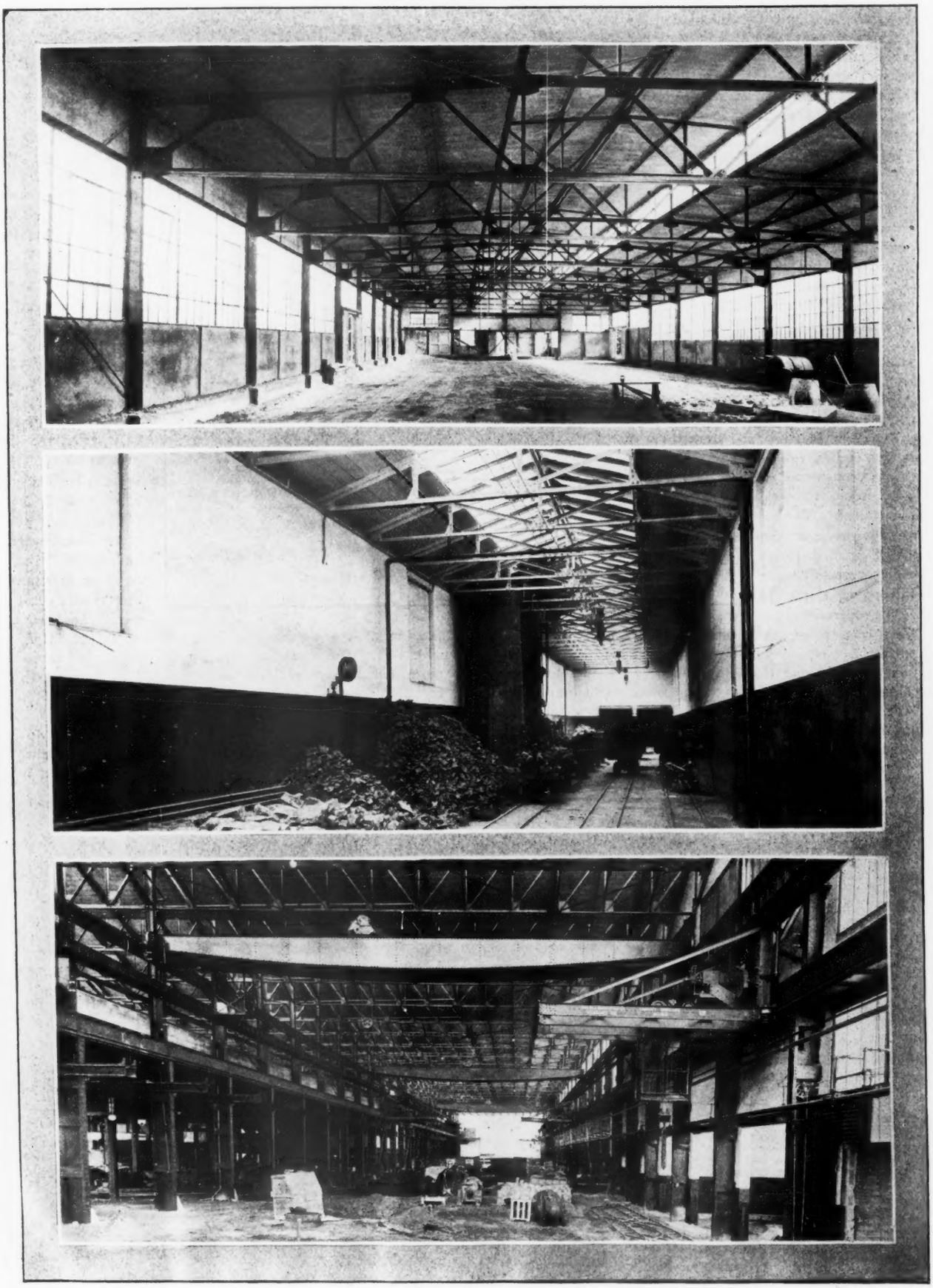


FIG. 8—A COMPARISON OF THREE ARRANGEMENTS OF NATURAL LIGHTING

The upper view shows a foundry lighted by means of continuous sash in the side walls and monitor. Light is admitted to the room in the next illustration through skylights. In the lower picture, the molding floor receives light from the sash in a saw-tooth roof.

vocated by E. S. Carmen in a paper presented at the 1915 meeting of the American Foundrymen's Association seems to offer a number of favorable points. A tunnel or basement extending the full length of the molding floor provides a foundation for piers which can be erected at the time the machines are installed. The floor of this tunnel should be at least seven feet below the ceiling and the width should be sufficient to allow a clear passageway on one side of the machines.

The walls of foundries have changed materially since the early days of the industry. Heavy massive masonry, permitting only small windows, has been supplanted by light curtain-walls containing continuous or large area sash. This change has been made possible by the use of steel columns and roof trusses, which carry the load of the building, thereby reducing the thickness of the walls to a dimension just adequate to safely support their own weight. The side walls may be constructed of brick, concrete, brick and hollow tile, or hollow tile. Of these materials brick and concrete cost about the same, while hollow tile with brick facing, and hollow tile alone are considerably cheaper. Brick is used more extensively than any of the other materials and is in every way satisfactory.

In buildings whose design calls for structural steel columns, continuous sash may be used and in those in which the roof trusses rest upon masonry pilasters, the sash may extend from pilaster to pilaster. In either case, steel sash should be used, as it is considerably stronger than wooden sash, has desirable ventilating possibilities, and allows about 20 per cent more light to be admitted. The ventilating panels should include a sufficient percentage of the total area of the sash to provide an entrance for abundant fresh air from the outside. The admission of air near the floor of a foundry is the basis for natural ventilation. If these ventilators are within reach of the workmen, the simple hook-and-stable device for holding the pivoted sash in position will be found satisfactory. The panels in the upper side walls or in the sides of the monitor should be equipped with a simple operating device so that the ventilation may be regulated from the floor.

The problem of selecting the most suitable glass for foundry windows is far from being a simple one. The ideal glass would properly diffuse the light and at the same time would be capable of being easily cleaned. Factory ribbed glass, which has 21 ribs to the inch, fulfills the first requirement better than some other types, but some foundrymen object to it because its ribbed surface is difficult to clean. On the other hand, plain glass is easily cleaned. However, it offers little resistance to direct sunlight, which under certain conditions is injurious to the eyes of the workmen. Fig. 6 shows the difference in the quality of light admitted through plain and factory ribbed glass respectively. The illustrations, which are reproduced from photographs taken in connection with experiments made at the Massachusetts Institute of Technology, show that the ribbed glass distributes the light more evenly and over a much greater area than the plain glass. A few foundrymen contend that plain glass accumulates sufficient dust to dim the sun's rays, but this argument loses weight when it is pointed out that the principal function of windows is that of admitting light rather than absorbing it. Many designers have specified ribbed glass for pivoted sash which are subjected to direct rays of the sun, and plain glass for all other panels. It would seem that foundry windows might profitably be made the subject of practical experiments to determine the merits of the various kinds of glass. At the present time, double-strength plain glass is a few cents more expensive than factory ribbed glass. Steel sash including the glass and putty and other incidentals varies in cost from 45 to 60 cents per square foot, depending largely upon the size of the units, number and size of the pivoted panels, character of the glass and the amount of sash required. The sizes of glass most commonly used are 12 x 18 inches and 14 x 20 inches.

There are many materials in general use for roof construction. With the present high cost of structural steel, there is a tendency to utilize wood or

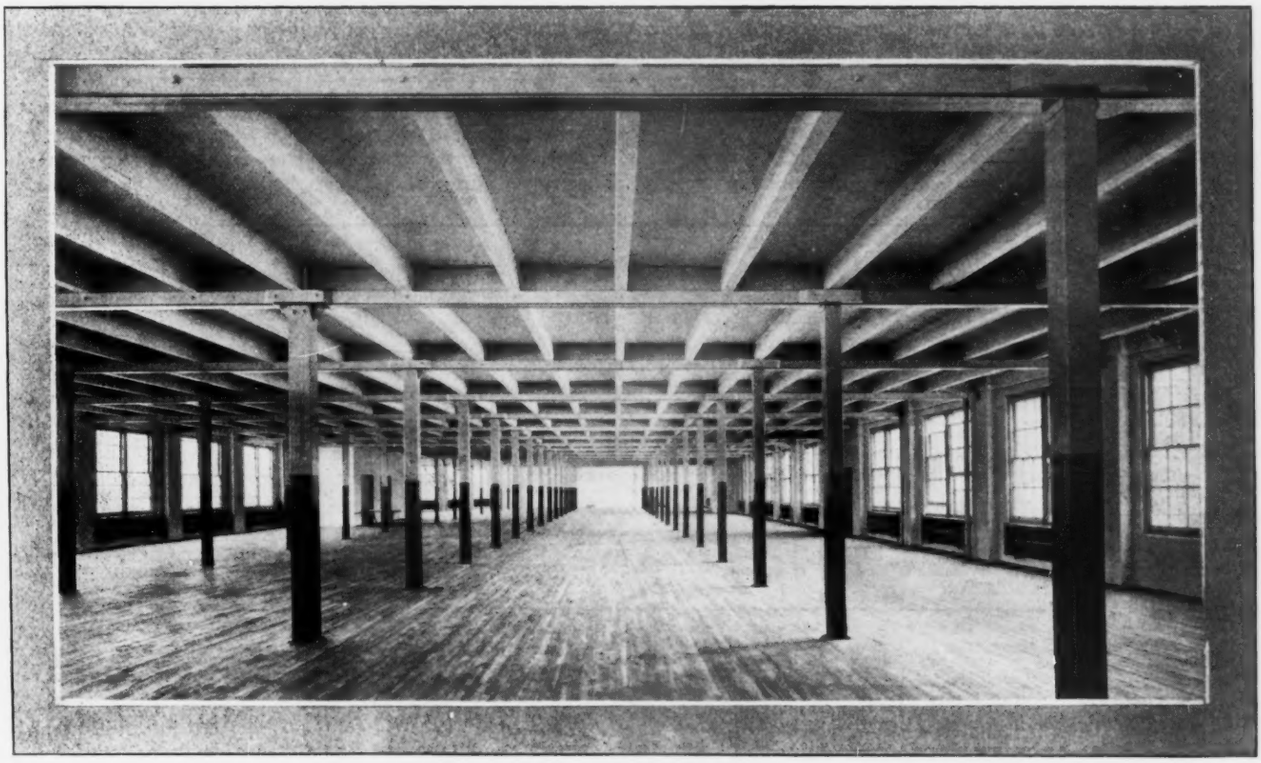


FIG. 9.—A GOOD EXAMPLE OF THE SLOW-BURNING TYPE OF MILL CONSTRUCTION

concrete wherever possible, and many builders are finding it advantageous to limit the use of steel to the columns and roof trusses, specifying long-leaf yellow pine purlin timbers, and tongue-and-groove roof-sheathing. This may be covered with slag, shingles, slate, metal or composition roofing. Slag roofs are used extensively and when properly laid are practically fireproof and will last from 10 to 20 years. Such a roof covering may be applied at a cost of about 5 cents per square foot. A number of combinations of felt, tar, asphalt, etc., in the form of rolls ready to put down make satisfactory roof coverings, and cost about the same as slag roofing. Wooden shingles present too great a fire hazard and asbestos and cement shingles are for too expensive to be used on factory roofs. Tin, copper and slate are seldom used on account of their prohibitive cost.

A more expensive roof construction consists of structural steel purlins on which a concrete slab roof is laid. Several patented commercial reinforcing materials have eliminated the use of temporary forms for the concrete and plaster. Also combination of gypsum, straw, and a reinforcing material is offered as a substitute for concrete. It is made in the form of blocks. When laid in place, such a roof is considerably lighter than one of concrete. Metal protected by asbestos makes a very satisfactory roofing. Several types of cement tile are now being manufactured, and these have some notable advantages which make them especially adaptable to the requirements of a foundry roof.

In addition to being fireproof, a roof of these materials is practically indestructible from natural causes, is strong and light, and may be economically maintained. Glass inset tile seems to have found favor among engineers and foundry managers, owing to the fact that it easily and cheaply serves the purpose of heavy skylights and monitors. George H. Hooper, in a paper read before the American Foundrymen's Association stated that, "since the inset tile is a more efficient lighting medium than the side-lighted monitor, we may as well dispense with this awkward and inartistic structure entirely and substitute for its ventilating features the hooded copper ventilator." A study of the types of buildings now being erected by foundrymen, indicates, however, that there is a strong aversion to giving up the monitor.

A concrete roof costs from 20 to 30 cents, the gypsum composition type varies from 15 to 20 cents and the tile roof averages from 15 to 35 cents per square foot.

Skylights were originally introduced for the purpose of admitting light to parts of a building not served by windows in the side walls, and in many cases, foundrymen prefer them to glass inset tile. The improved skylight bars, now on the market take care of the moisture formed by condensation and provide a waterproof lighting medium. The cost of skylights ranges from 35 to 90 cents per square foot.

The problem of heating and ventilating the foundry deserves the closest attention of the prospective builder. In the *Transactions* of the American Foundrymen's Association for 1913, W. H. Carrier enumerates the requirements for a thoroughly adequate heating and ventilating system as presented below:

Table II

APPROXIMATE COST OF INDUSTRIAL BUILDINGS

	Cents per Cubic Foot*
Saw tooth building, structural steel, brick walls, steel sash, high grade floor and slag roof	9 to 12
High monitor-type building, structural steel, brick walls, steel sash, first class floor and slag roof	6 to 7½
Reinforced concrete building, steel sash, maple floors, brick spandrel walls, steel sash and slag roof	12 to 15
Same as above (6 to 11 stories)	12 to 15
Multiple story, slow-burning type of mill construction, brick walls, wood sash and slag roof	10 to 12

*Complete building including lighting and heating. Estimates in McGraw-Hill *Mechanical Engineers' Handbook.*

1.—Desirable temperature.
2.—Even distribution of heat.
  (a) Prevention of cold drafts.
  (b) Economic applications of heat to avoid radiation of heat out of doors, and over-heating of unoccupied space.
3.—Ample ventilation when needed.
4.—Rapid heating of building in the morning.

In considering an apparatus to meet these requirements the cost of installation and economy of operation and maintenance should be taken into account. In discussing the various types of heating systems, Mr. Carrier writes as follows:

"Coke or gas fired salamanders are apparently the most economical form of heating, as all of the heat goes directly into the building. The atmosphere in a tightly closed building heated by this method becomes intolerable, and if sufficient ventilation is provided to make conditions healthful, then the amount of heat required is greater than with other systems. The grade of fuel required is also considerably more expensive than other systems of heating, to say nothing of the care of a large number of separate fires scattered around the building.

"In heating with direct radiation, steam is usually employed, although hot water systems with forced circulations have been successfully operated. Unless there are large amounts of hot water available it is not an economical system to install on account of the greatly increased amount of radiation which is required at the lower temperature. In steam heating either the high pressure, the low pressure or the vacuum system of distribution is employed, the selection of the particular system depending on the local conditions. Where high pressure steam is available and there is no exhaust steam, it should be used because steam at 100 pounds gives approximately 75 per cent more heat per square foot of radiating surface than steam at five pounds owing to its higher temperature. However, if there is no high pressure steam or exhaust steam available from the power plant then an independent low pressure boiler should be installed to furnish steam at from five to 10 pounds pressure. Probably the most satisfactory method of arranging the direct radiation is by means of mitre type coils placed alongside the outside walls between the windows, the main lengths of pipe being vertical to avoid accumulation of dust and to obstruct the side walls as little as possible. Several rows of pipe are also run along the side wall of the monitor roof just above the crane. This is to provide for the radiation of heat through the roof and skylights and to prevent cold down draughts which would otherwise occur. Such distribution of radiation is not efficient, but it is the only practicable method in this type of building.

"The best system for foundry heating and ventilation is undoubtedly the fan system; it is particularly adapted to the severe requirements of foundries and other buildings where there are large open spaces to be heated."

Heat from the fan system may be distributed by means of large pipes suspended from the columns at each side of the main bay. Ducts along the walls may be provided to heat the fresh air admitted from the outside through the lower ventilating sash. A more expensive system in which the distributing pipes are laid in ducts under the foundry floor, is used in foundries where

conditions warrant the extra expenditure.

In modern foundries considerable attention is being paid to the construction of floors. Foundrymen of the old school are inclined to insist that there is no substitute for clay and molding sand as materials for the molding-room floor. In plants where large castings are made in molds requiring deep pits, or where a floor would interfere with operations, there is no answer to this contention, but in plants where comparatively light castings are made it will be found that a floor will contribute to the efficiency of the workmen. A good floor reduces the amount of sand required, encourages the habit of keeping the shop in orderly condition, and minimizes the danger of accidents. In shops where floors for the entire molding room are out of the question, it is advisable to lay a runway through the center of the building, and from this central aisle to the various doors and auxiliary departments. Such a passageway will facilitate the trucking of materials, and will serve as the starting point from which all efforts to keep the shop in a clean condition will radiate.

A number of materials have been used in the construction of floors, but most of them have proved unsatisfactory. Ordinary concrete cracks when hot metal is brought in contact with it and cast iron plates, while satisfactory in many respects, cannot be used extensively on account of their excessive cost. Both of these materials make a hard footing for the workmen. Satisfactory floors and runways may be made of a mixture of one part cement, three parts sand, four parts gravel and one part iron borings. This modification of concrete, reported to have been first used by the Crane Co., Chicago, does not crack when metal is spilled upon it.

Wood Blocks Make Good Floor

In other parts of the foundry, where a durable floor is required, and where workmen are constantly treading on it, creosoted blocks prove most satisfactory. The blocks are made of southern yellow pine, hemlock, larch douglass fir, black gum, beech or maple, and are treated with creosote oil which is forced into the wood under pressure. The blocks may be laid over a base of tamped cinders or over a ½-inch sand cushion on a 6-inch concrete sub-base. The blocks now being manufactured are either rectangular or hexagonal in shape, and for floors subjected to a wide range of temperatures or to excessive dampness, blocks with lugs to provide for expansion are furnished.

The cost of creosoted wood block floors averages about $1.50 per square yard for the blocks alone and about $2.40 per square yard for the completed floor. The depreciation is said to amount to less than 3 per cent per year. Wood blocks make excellent floors for cleaning, core and shipping rooms because of their ability to stand the wear imposed by the handling of rough, heavy castings. Fig. 7 shows a wood block floor installed in a steel casting plant.

Painting and Cleaning

The expenditure of considerable money for painting the interior of a new building is justified by the improved conditions resulting from bright walls and ceilings. The effect of adequate windows and improved artificial lights is lost to a considerable extent if the interior of the foundry is so dark and dirty as to absorb the light rays. If plain single-web members are specified when the structural details are worked out, the task of painting and cleaning columns and roof trusses will be simplified. Unnecessary irregularities in the walls, ceilings and corners of the interior should be avoided when the details are being drawn up. Fig. 1 indicates the bright and clean appearance of a foundry in which the interior is painted and kept clean.

The subject of artificial lighting should receive more attention now than ever before, for under present conditions, it is necessary in many cases to work the foundry night and day to keep up with orders. Therefore the plant equipped with good lighting facilities has a tremendous advantage over the poorly-lighted establishment. The essential requirements of good artificial lighting are that there shall be sufficient light of the proper quality on the work, that there shall be a moderate intensity of light over the adjacent area and on the walls, that there be an absence of glare, and that the lighting systems be simple, reliable, easy of maintenance and low in operating cost.

Intensity of light is measured in foot-candles. A foot-candle is the intensity of illumination on a surface normal to the light rays at a distance of one foot from a source of one candle power. It has been agreed that for foundry practice, three foot candles represents the proper intensity.

Light of this intensity, however, must come from several directions so that all sides of an object may be properly illuminated. For this reason it is more advantageous to have a large number of small units than a few large units. In installations of few large units, the shadows are likely to be too pronounced. On the other hand, there is a limit to which small lights may be used economically. The best arrangement is secured when the horizontal distance between the sources of light is about one and one-half times their height above the work. This relation holds good in all cases regardless of the candlepower of the units which are used.

Steadiness of light is an extremely important requisite of a good lighting system. A flickering light is uncomfortable to work under to say the least. The eye of the workman endeavors to adjust itself to suit the light, and if the light is unsteady, the iris is constantly strained in trying to adapt itself to the rapid changes. A glaring light is just as undesirable as a flickering one and should be avoided. Glare may be overcome by placing lights of high brilliancy in such positions that the direct light will not be readily seen, except at a considerable distance. When it is impossible to screen strong lights, reflectors may be used advantageously. Under no consideration should bright lights be so situated that they are visible to a workman when he is bending over his work.

Electric lighting, on account of the fact that it most satisfactorily fulfills the foregoing conditions, is usually used in foundries. Acetylene, and natural and artificial gas may be found in a few localities, but the average conditions surrounding a new plant will warrant the installation of an electric system.

Of the various types of electric lamps, the incandescent lamp of from 25 to 1,000 watts is being used more extensively than any other kind. Arc lamps, and clusters of small incandescent lights are fast giving way to the tungsten filament type.

The cost of lighting should include three distinct charges. The fixed charge consists of interest on the investment, depreciation of permanent parts and other expenses independent of the number of hours the lamps are used. The maintenance charges include the cost of renewal of parts, repair labor, and all costs except the cost of energy which depends upon the number of hours the lamps are burning.

Cost of Lighting

As a guide to the cost of electric lighting, Table I containing information furnished by the engineering department of the National Lamp Works of the General Electric Co. is presented. It must be remembered that the prices of lamps and reflectors vary, and that the calculations are shown solely for convenience in engineering estimates.

Plumbing at the best is expensive, and there are foundrymen who are of the opinion that it is a waste of money to provide an extensive system of wash rooms, toilets, drinking fountains, etc., throughout the shop. In selecting plumbing fixtures, the foundry designer

must know something about the manner in which the shop is to be operated. If it is to be intrusted to a manager who is unmindful of the conditions under which the workmen labor, there is no necessity for installing expensive plumbing, for it will rapidly depreciate on account of lack of attention. Wash rooms, and their equipment should be placed under the care of attendants who should be made responsible for keeping the apparatus in the best possible condition. If this policy is followed, the foundry owner is justified in spending considerable money for plumbing and sanitation, and in the long run, his foresight will be appreciated by the men. The expense of wisely planned facilities which improve working conditions will bring in unexpected returns in the way of good will, efficiency, and general good health of employes.

The Multiple-Story Building

The multiple-story buildings used for foundry purposes are of two distinct types. In casting plants having the melting and molding departments in a single story building, and the other departments in a multi-story structure, the latter building is usually of simple reinforced concrete construction. Since most of the structure is devoted to the storage of patterns, to drafting rooms, offices, etc., involving no special requirements in the way of structural design, a standard type of building proves entirely satisfactory. Such a building may be supported on concrete columns spaced 20 feet apart each way. Floors of reinforced concrete slab construction may be employed to eliminate the use of heavy beams and increase the head room. The walls may be of reinforced concrete or brick or a combination of the two materials. Steel sash extending between the wall columns is used, and the roof may be constructed of almost any of the materials mentioned in connection with one-story buildings. Wire glass and concrete curtain walls should enclose all elevator shafts, and all rooms should be equipped with automatic sprinklers. Sprinkling systems cost about $3.00 per sprinkler.

The second type of multiple-story foundry building is that which is designed to contain all of the manufacturing departments under one roof. Most of the continuous foundries making a great number of small castings are now being built according to this plan. George K. Hooper, in a paper read before a meeting of the American Foundrymen's Association, discussed this kind of construction. He said in part:

"In place of the single-storied building, with crane or cranes carried on columns or on side walls, with a light steel or wooden truss sufficient only to carry a roof of comparatively light construction, we have a building of heavy and modern steel design capable of sustaining machinery loads of considerable weight, and of absorbing the vibratory stresses and shocks imposed by this equipment.

"In cases where the product can be routed more economically by the adoption of multi-storied buildings, foundries of two or more stories are becoming common.

"Preferably, in my experience, the structure takes the form of a steel skeleton with curtain walls and masonry pilasters, concrete floors, metal sash windows, in some cases with heavy steel trusses supporting a roof of one of the acceptable forms of concrete tile now available."

The details of such a structure would depend entirely upon the nature of the work and the methods of manufacture. The sand-handling equipment, including the distributing system, storage facilities, mixing apparatus, etc., would play an important part in the design of the building, as would the number and kind of molding machines used, the size and shape of the castings made, and the type of melting equipment used. On account of the wide variation in the requirements of continuous foundries of the multiple-story type, it is impossible to describe any one design that would be applicable to a number of plants.

Mill Construction Building

In some localities, especially in New England and the far west, mill construction buildings are adopted in preference to structural steel. Mill construction is the term commonly given to that type of building construction in which the interior framing and floors are of timber, arranged in heavy solid masses, and smooth flat surfaces, so as to expose the least number of corners, and to avoid concealed places which may not be reached readily in case of fire. A building of this kind, when equipped with an adequate automatic sprinkler system presents a low fire risk, and is suitable for multiple-story pattern storage, pattern shops, etc. Fig. 9 shows the floor construction of a typical mill type building.

It is exceedingly difficult to estimate the cost of buildings at the present time on account of the abnormal condition of the building material market. Table II, which shows only comparative costs, was based on estimates made before the present war prices came into existence, and therefore must not be taken to represent the uncertain conditions now prevailing.

Powdered Coal as a Fuel in Malleable Shops---I

By Joseph Harrington[1]

COAL suitable for pulverization is found almost all over the United States, and includes substantially the entire range of bituminous fuel. The special requirements of the malleable furnace, however, restrict the number of grades available due to the necessity of employing a fuel which does not contain an excessive amount of sulphur. So far as the ability to both pulverize and burn coal is concerned, any bituminous coal can be used.

In hand-fired air furnaces, West Virginia splint or Youghiegheny coal is almost universally employed, although certain coals from Illinois and Kentucky have as low a sulphur content as these. The influence of custom on the selection of coal is still strong, and the western coal has not generally entered the field for this reason. It does, however, make an interesting competitor of the eastern coals on account of its location within an immense territory which can be served at a much lower freight rate than from the Virginia and Pennsylvania fields. Pulverization makes it possible to take advantage of these cheaper fuels.

The structure of coal is such that it breaks down much more readily when the moisture content has been removed. It is a practical economy, therefore, to dry the coal desired for this service until less than 1 per cent of moisture remains. The drying apparatus, as is the case with all of the pulverizing machinery, is commercial equipment, manufactured by a number of companies on a competitive basis. The dryers are usually of the rotary type, wherein a long, inclined cylinder is supplied with coal at one end, which gradually travels the length of the cylinder in contact with hot air or gases from a specially constructed furnace. Upon emerging from the dryer, the coal is elevated to a receiving hopper

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placed in suitable relation to the pulverizer. This equipment, also highly standardized, will reduce the coal to an extreme state of fineness. The accepted standard for this is that 95 per cent shall pass through a 100-mesh screen, and 85 per cent through a 200-mesh screen. When so reduced there is no perceptible grain when a little is rubbed between the fingers, and when blown from the palm of the hand, the coal will remain in suspension in the air an appreciable time. The fineness of the pulverization is one of the secrets of success in handling this fuel.

The entire theory and practice is based on the complete burning of the coal while remaining in suspension in the furnace. Not only do the proper combustion conditions depend upon the dryness and fluidity of the coal, but the distribution by pneumatic means is directly affected. Coal in this condition can be conveyed in a current of air for hundreds of feet, and this is one of the simplest and most efficient means for distributing it.

When the coal has been properly pulverized it is elevated to a storage tank from which it can be distributed at will to any part of the foundry. It is an economy to have this storage tank of considerable size, so that enough coal can be carried to prevent the possibility of a furnace shutdown, should an accident happen to the drying or pulverizing machinery. The probability of mechanical trouble with this type of equipment is no greater than in any other part of the plant, but accidents will sometimes occur.

Safety of Pulverized Fuel

There is no practical danger in storing considerable quantities of this fuel, because it will not burn when in a compact state. Only when suspended in the proper density in a current of air does explosibility occur. A heap of pulverized coal can scarcely be ignited, and when contained in a tight steel hopper may be considered perfectly safe. With modern understanding of the requirements of this service no excuse can be offered for coal dust in either the pulverizing department or around the furnaces. Coal can be prepared in a room that is practically clean, and a dirty pulverizing department is no more to be excused than a dirty engine room or office.

A matter that will early come to the minds of those interested is whether or not the cost of this fuel is prohibitive. Like all other products, the rate per ton is reduced as the quantity is increased. Figures derived from numerous installations show conclusively that with all of the overhead which can be charged to such an installation, with a considerable allowance for contingencies and with full allowance for depreciation, that coal can be dried and pulverized for 40 cents per ton. Without allowing for interest or depreciation, but charging the plant with the actual manufacturing costs, 25 cents per ton will be the outside figure in everything but the smallest installations. It is my custom, however, in making estimates for these installations to allow 50 cents per ton in all cases. This is large enough to cover all possible charges, and in the majority of instances affords a snug margin when the actual cost is figured. How quickly even this figure is absorbed in the economies derived from this fuel, will be shown in detail later. It is sufficient at present to state that the total reduction in the cost of melting and annealing malleable iron is so great that the pulverization cost is easily taken care of.

The use of powdered coal is not new, but the successful application of this fuel can be considered as having been developed within very recent times. It is no discredit to this fuel that difficulties have been encountered. Taken all in all, the failures have been relatively fewer than those recorded in the development of the majority of the mechanical marvels of this age.

There is no denying the fact that radical errors were committed by the early experimenters. Much of this work was done by those untrained in either the science or art of combustion engineering. The old saying that bad news travels fast, is just as applicable here as elsewhere, and the report of trouble remains in the minds of those who should know the truth with a persistence that makes the progressive engineer wonder. Powdered coal, however, enjoys certain inherent advantages which will compel it to take place in the front rank of modern economies, and the difficulties reported can no more retard its advance than the early failures of the aeroplane or submarine. Savings which are directly attributable to the use of this fuel are of such magnitude as to challenge the attention of all, and only a few years will be required to establish the use of this fuel as one of the few means of furnace heating in the metallurgical arts.

Powdered Coal for the Malleable Plant

This is the first of a series of articles that will present the requirements and the results of the use of pulverized coal as a fuel in both malleable melting furnaces and annealing ovens. The general topics to be discussed in this series of articles follow:

1—Preliminaries, with general description of powdered coal; the requirements and equipment for pulverizing; approximate costs and danger in use; prophesy.

2—Character of the flame and control over the excess oxygen; oxidation of the metal and temperature of combustion; furnace design.

3—Effect of radiant heat and saving in furnace walls due to utilization of same; insulation of furnace roof by air curtain; influence of direct contact of fuel and metal.

4—Annealing oven; application of powdered coal; control and distribution of heat; reduction in pot loss; temperature control; improvement in metal quality; oven design.

5—Uniformity of furnace conditions; absence of smoke; reduction in losses due to hand firing methods; rapidity of heating and control of heat zones.

6—Some actual figures on cost of installation and designs of plants; methods of distribution, application, etc.

Pig Iron Production First Half of 1916

According to statistics compiled by the American Iron & Steel Institute, the pig iron production of the United States during the first half of this year was at the rate of nearly 40,000,000 gross tons annually. During the first six months, 19,619,522 tons of pig iron were produced as compared with 12,233,791 tons the first half of last year and 17,682,422 tons during the last six months of 1915. Out of a total of 446 blast furnaces, 344 were in operation the first half of this year against 310 on Dec. 31, last year.

Charcoal iron showed a big gain in production during the first six months of this year over the output of the first half of 1915. This year's half-yearly output was 191,996 tons, against 129,496 tons the first half of 1915 and 166,656 tons the last half of last year.

Foundry pig iron was produced at the rate of over 6,000,000 tons annually based on the production the first half of this year, when the output was 3,086,410 tons which is a big increase over the total of the first six months of 1915, when 2,207,375 tons were produced. During the last half of last year the total output was 2,656,973 tons.

The decline in the output of malleable pig iron the first half of this year as compared with the last half of last year is surprising, although the rate of production the last six months of 1915 was 1,100,000 tons annually, when 551,409 tons were made. During the first half of this year the production was 460,839 tons, against 278,512 tons the first half of last year.

The Ingersoll-Rand Co., New York, has issued a four-page bulletin, describing an air-operated pick which is particularly adapted for breaking cores in foundry work.

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On to Cleveland

JUST a decade has elapsed since the foundrymen of North America met in the Forest City. That gathering in 1906 was unusual in many respects. It marked the beginning of the exhibition movement which since has grown to tremendous proportions, and it rekindled the flame of the organization spirit among casting manufacturers. Although it had been organized ten years prior to the first Cleveland meeting, the American Foundrymen's Association had only a few hundred members at the time of this convention. With the exhibition as an added attraction, the attendance was the largest in the history of the society, and appreciating the benefits to be derived therefrom, it has been carefully fostered as one of the valuable educational features of these annual events. What wonderful progress has been made in foundry practice in a span of only ten years is best reflected by contrasting the two Cleveland shows. In 1906 only a few builders of molding machines were represented, whereas at the show to be held during the week of Sept. 11, a greater floor area will be devoted to these labor-saving devices than to any other class of equipment used in foundries. From a novelty in 1906 the molding machine has grown into a necessity in 1916. Accident prevention was an unheard of folly a decade ago, whereas safety appliances today are everywhere in evidence and the movement has the co-operation of both employers and employes. To safeguard the lives and limbs of workmen, many devices have been introduced, and one section of the large exhibition hall at Cleveland will be set apart for this safety display. Equipment for conveying materials of every conceivable kind will be shown, whose introduction has eliminated much of the arduous labor that attended foundry operation in 1906. To attempt to record the progress that has been made would involve recounting the forward strides in the most phenomenal period of advancement in the history of the foundry trade. What changes have taken place in mechanical manipulation have been paralleled in melting practice, the utilization of electricity for this purpose not even having been considered ten years ago. And the freedom of discussion of the technicalities of the founder's art is indicative of a tremendous change in the attitude of those engaged in this industry toward the disclosure of so-called secrets. Today, the foundryman who does not freely discuss his methods and practices is labeled unprogressive, and it is generally assumed that he has nothing worth while to conceal. Publicity is the foundation of this great awakening and fostered by an annual interchange of ideas, the advancement of the last decade has been made possible. The affair at Cleveland in September will be a triple event, including the annual meetings of the American Foundrymen's Association, the American Institute of Metals and the exhibition of foundry equipment and supplies. Forget your troubles for a week. Come to Cleveland and bring your shop executives. You'll all benefit and, besides, everybody'll be there.

Labor difficulties and demand in excess of the melt are the outstanding features of the casting industry today. The buying of pig iron, particularly by steel foundries, has reached a large volume and prices are being firmly maintained. In the leading centers, foundry grades are quoted as follows: No. 2, Pittsburgh, $19.45; Cleveland, $18.50; Chicago, $19; Philadelphia, $19, and Birmingham, $13.50

The Proper Blast for an Efficient Air Furnace

How the Best Results may be Obtained and Economies in Melting may be Effected by the Proper Direction of the Blast

By Harold Hemenway

IN THE operation of the air furnace for malleable work it is essential to consider the blast required to maintain the furnace at its highest efficiency. The coal consumption, time of heats, and the cost of fire brick used in the upkeep of the furnace must be considered in trying to obtain perfect combustion from the fuel. It is impossible to establish a rule to govern operations as furnaces vary in size, the grate area changing in proportion to the size of the melting medium. Almost perfect results can be obtained if operations are well controled. This is of great importance, since good combustion insures economies in fuel consumption, and with the proper control of the furnace, greater uniformity of product ensues.

The setting of the bungs in the furnace is of utmost importance if efficiency in operation is to be attained. The brick used for the bungs are laid up in a box containing a frame conforming to the shape of the angle bungs. When placed on the furnace, the completed bungs are in a straight line with the curved sides facing each other. An arch brick placed between them serves to key them firmly in place.

The wind bung is set in a slanting position next to the angle bungs. The blast pipes are placed at approximately the correct angle in six tapered openings in the wind bung. As the pipes extend only part way through the bung, the direction of the top blast is not completely controlled by their position. This causes the blast to be directed against the sides of the bung, from where it is deflected down into the furnace. In most cases this results in burning holes in the furnace lining and invariably it produces an uneven melting action upon the metal. The unmelted iron must then be worked down into the molten portion, making it necessary to shut off the blast. The furnace is cooled down by this procedure, and much of the value of the fuel is wasted.

These conditions may be improved by directing the top blast at the proper angle as it enters the furnace. This is most easily accomplished by placing a clay pipe inside of the bung, so as to throw the flame down against the bottom lining. In a furnace having a decided slope at the neck, it has been found that when the clay pipe is inclined at an angle of 43 degrees, the blast flame clears the bungs and strikes the bottom 30 inches from the angle.

The pipe is made by placing clay in the opening in the brick in which the blast pipe is set. By making the inside diameter of the clay pipe slightly larger than that of the blast pipe, and by carefully modeling the walls to properly direct the blast, satisfactory results may be obtained.

A second set of top blast openings in the face of the bridge wall at the top are used in this furnace. These openings, which alternate with those in the wind bung, are set at an angle of 26 degrees. This allows the flame to clear the angle bungs and to strike the bottom at a point about four feet from the angle.

Proportioning the Air

After the volume of air required to operate the furnace has been carefully determined, it is necessary to proportion the amount between the top blast and the grate blast. In most cases this will give less blast under the fire and will increase the amount of top blast generally used. The reduction of the amount of air entering from under the grate slows down combustion in the firebox, and with proper firing, allows the gas to generate and enter the furnace where it mixes with the top blast. If the top blast pipes are inclined at the proper angle, the blast follows the course of the flame and becomes part of it. As it is directed low in the furnace, it will cut through the pig and sprue without hurdling over it. This will cause the time of the heat to be shortened considerably.

Much has been said in regard to the importance of the radiation of heat from the bungs, but there seems to be some doubt as to the value of this theory. If furnaces were operated on the assumption that the radiated heat is of the greater value, the flame would pass high up into the furnace, and while the metal would be satisfactorily melted, the operation would be extremely slow, as the flame would not sweep down upon the bath. The cost of maintenance of such a furnace would be considerably increased because a high grade, expensive brick would be required for the bungs. The ordinary type would burn out rapidly if subjected to the heat of a melting unit operated according to the radiation theory.

In a furnace with the bung blast pipes properly set, and with the top and bottom blasts carefully regulated, conditions are ideal for prolonging the life of the bungs. Ordinarily, in such a furnace, the angle bungs withstand from 30 to 60 heats depending largely upon whether they are broken by iron accidently thrown against them in charging. The other bungs in the furnace proper have a life of from 50 to 175 heats. The bungs on the waste-heat flue leading into the stack last indefinitely, and frequently go through an entire season without showing any effects from the heat.

The use of clay pipes allows the outside pipes to be inclined toward the center slightly so that the flame and metal will not be thrown against the side walls. This prolongs the life of the brick and is an important factor in economical operation of the furnace. The blast in the bridge, which enters through the second set of pipes, protects the bridge from extreme heat, and prevents it from cracking.

The time required for a 10½-ton heat in this furnace is from four to 4½ hours. The metal is 13½ inches deep. It is believed that with a wider furnace, in which the depth of the metal could be reduced to about eight inches, better results could be obtained.

Furnace efficiency seems to be greatest when the blast pipes are directed so as to hold the flame low in the furnace, and when the proper relation between the top and bottom blasts is maintained. Under such conditions one grade of low priced fire brick may be used for both walls and bungs; also the time of heats will be reduced to a minimum. Almost perfect combustion may be obtained, the losses amounting to less than 5 per cent.

A New Electric Vibrator

In the accompanying illustration is shown an electric vibrator which is being introduced to the foundry trade by the E. J. Woodison Co., Detroit. It will be noted that in this view it is attached to the pattern plate inserted between the cope and drag flasks, a knee vibrator attachment also being indicated, as well as the attachment to a lamp socket for the electric current. While the vibrator is exceedingly small and light, the blow or vibration is sufficient for the work for which it is intended.

ELECTRIC VIBRATOR ATTACHED TO A PATTERN PLATE, SHOWING KNEE PAD AND LAMP SOCKET CONNECTIONS

The frame of the vibrator is built-up of strong laminations and of a form which insures an efficient magnetic circuit. It has no loose, movable parts, requires no lubrication and the only wear is on the two pounding surfaces, which are large and are hardened to withstand this service. It can be attached to any lamp socket and, therefore, may be employed in any part of a casting plant where it may be required. It is built to operate on 110 and 220-volt alternating current of either 30 or 60 cycles. The vibrator is enclosed in an aluminum case, thereby making it dust-proof. Based on an eight-hour day, with the vibrator operating one minute out of four, the cost of power per day varies from 08 to 2 cents. Therefore, it is apparent that the operating cost is practically negligible; these figures are based on a power cost of 5 cents per kilowatt-hour.

New Electric Steel Plant

A new electric steel casting plant is under construction at Hartford, Conn., for the Connecticut Electric Steel Co., Inc. The plant will consist of two steel frame buildings, one 66 x 120 feet and the other 60 x 80 feet. A 2-ton Heroult electric furnace will be installed for the production of basic steel castings and ingots. The plant will be equipped with the usual foundry appliances for the production of specialty and jobbing work. The plant will be placed in operation about Oct. 1. Edwin L. Willson, 50 Church street, New York City, is president of the company.

Walter E. Holloway, formerly affiliated with the Argus Smelting Co., New York, has incorporated the Walter E. Holloway Co., 320 Broadway, New York, which has been organized to engage in the sale of copper, tin, spelter, lead, aluminum, ingot brass and bronze mixtures.

Douglas Walker, Chicago district salesman for the Snyder Electric Furnace Co., Chicago, Ill., has been appointed sales manager.

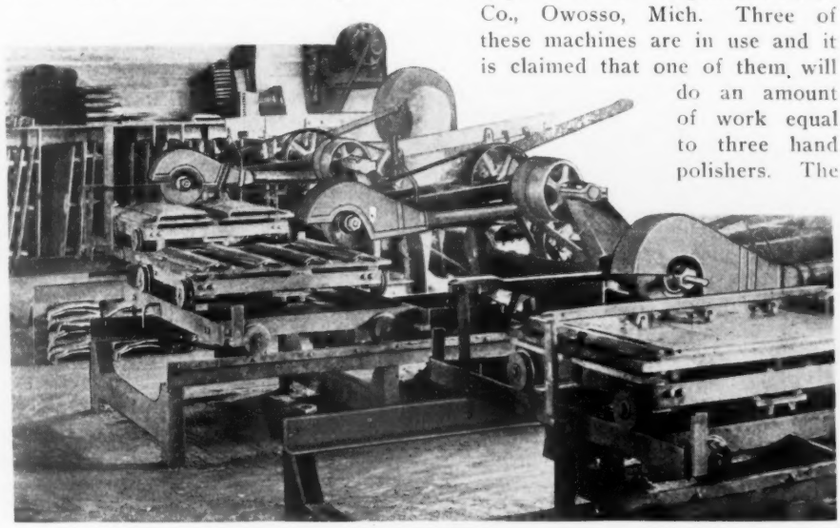
Canada's Pig Iron Production

During the first half of this year, the foundry pig iron production of Canada showed a tremendous increase over the same period in 1915. The output of foundry grades of iron during the first six months of 1916 aggregated 95,602 tons as compared with 59,646 tons during the same period last year. The total foundry iron production in 1915 was only 123,769 tons as compared with 174,346 tons the previous year, a decline of 48,577 tons. At the present rate of production, however, the 1916 output will total approximately 190,000 tons.

Grinding and Polishing Stove Tops Automatically

A few years ago the superintendent of one of the large stove factories was confronted with serious problems in the polishing department of his plant. He undertook to solve them by building an automatic polishing machine. That it was successful is evidenced by the fact that the machine immediately came into general use for grinding and polishing flat, semi-flat or oval castings, iron and brass plates, and sheet steel requiring a superior finish.

An unusually interesting operation is that of grinding and polishing stove tops. The accompanying illustration is a view of one of these machines in the plant of the Independent Stove Co., Owosso, Mich. Three of these machines are in use and it is claimed that one of them will do an amount of work equal to three hand polishers. The stove top is first mounted or assembled with centers and covers after the castings have been taken from a pickling solution to remove a portion of the scale. The top is then placed on the machine and is first roughed with a Crystolon wheel,



POLISHING STOVE TOPS IN THE PLANT OF THE INDEPENDENT STOVE CO., OWOSSO, MICH.

10-inch diameter, 2-inch face and of 60 or 90 grit. After this operation, the top is dry-fined and finished or oiled with abrasives ranging in grit from 80 to 150.

The quality of the work done on an automatic polishing machine depends largely upon the selection of the grinding wheels and abrasives. It is claimed that by using the proper wheels a finer degree of work can be obtained than by hand and at a saving in polishing from 50 to 75 per cent.—*Grits and Grinds.*

Napoleon Petinot has severed his connection with the Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

Pig Iron for Makers' Use and Sold in Open Market

One of the interesting features of the report of the half-yearly production of pig iron of the United States during the first half of this year is the large tonnage used direct by the plants operating blast furnaces, as compared with the tonnage sold. While the output during this period was 19,619,522 tons, 13,859,137 tons were produced for makers' use and 5,760,385 tons were disposed of in the open market.

Of the total production of foundry iron, amounting to 3,086,410 tons only 48,764 tons were for makers' use whereas 3,037,646 tons were offered for sale. The disposal of other grades of pig iron was as follows: Basic, 8,830,085 tons produced, of which 7,585,178 tons were for makers' use and 1,244,907 tons were sold. The bessemer and low phosphorus output was 6,839,177 tons, of which 6,037,585 tons were for makers' use and 801,592 tons were sold. The entire malleable iron production of 460,839 tons, of course, was disposed of in the open market. Of the total ferromanganese production of 99,951 tons, 23,510 tons were sold in the open market and 76,441 tons were for makers' use. The spiegeleisen output was 89,095 tons of which 74,886 tons were sold and 14,209 tons were used direct.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The National Mfg. Co., Franklin, Ind., recently incorporated, will build a foundry.

The North End Foundry Co., West Allis, Wis., will build an addition to its plant.

The Orbon Stove & Range Co., Belleville, Ill., will erect an addition to its foundry.

Alfred A. Viau, St. Jerome, Que., Can., will build a foundry at a cost of $6,000.

The Edward Maher's Sons Co., Newark, N. J., will build an addition to its foundry, 34 x 160 feet, at a cost of approximately $20,000.

The Globe Iron Works, Duluth, will construct a foundry at its plant at 435 Lake avenue.

The Vandalia Machine & Welding Works, Vandalia, Mont., is building a machine shop and foundry.

The Raymond Foundry & Machine Co., Raymond, Wash., will rebuild its plant recently burned, at a cost of $18,000.

A two-story, fireproof pattern shop is being erected for the Sharon Foundry Co., Wheatland, Pa.

The Mauch Chunk Iron Works, Mauch Chunk, Pa., will shortly build an addition to its foundry.

The Yellville Machine Shops & Foundry Co., Yellville, Ark., will build a foundry, 40 x 24 feet, and a machine shop, 30 x 60 feet.

A contract has been awarded for the erection of a 40 x 140-foot casting shop for the Connecticut Brass Co., Cheshire, Conn.

The Pyott Foundry Co., 955 Carroll avenue, Chicago, will erect a two-story plant at a cost of $75,000.

The Holt Mfg. Co., Peoria, Ill., manufacturer of tractors, will build a 116 x 250-foot steel-frame foundry building.

The Link-Belt Co., Chicago, contemplates erecting an addition to its foundry at Indianapolis, at a cost of $300,000.

The Adrian Steel Castings Co., Adrian, Mich., will rebuild its plant, recently damaged by fire, at a cost of $40,000.

The Wisconsin Foundry & Steel Works, Cedar Grove, Wis., has changed its name to the Cedar Grove Stove Co.

George I. Gardner and W. B. August, Stockton, Cal., have established a foundry in the old Globe Iron Works plant.

Mann & Fritz, Seattle, Wash., will open a foundry in Seward, Alaska, for general repair work.

The plant of the Rogers Foundry & Machine Co., Joplin, Mo., recently burned, will be rebuilt and the equipment replaced.

The Stege-Rindt Plating Co., Louisville, Ky., has changed its name to the Stege-Brassard Plating Works.

A company represented by Frank A. Walsh and L. Hyde, West Allis, Wis., has acquired the Cedarburg Foundry Co., Cedarburg, Wis.

The Kohler Mfg. Co., Kohler, Wis., manufacturer of plumbing goods and enameled ware, will build a one-story addition to its plant.

The Pratt & Letchworth Co., Buffalo, is erecting a brick and steel addition to its foundry and a pattern storage building.

The Indiana Die Casting Co., Indianapolis, will erect a concrete building, 45 x 85 feet, saw-tooth construction, in which it will install die casting machinery.

E. I. du Pont de Nemours & Co. have purchased the old Norton Iron Works plant at Boonton, N. J., and are equipping it as a brass and bronze foundry.

The Enterprise Brass Works, Muskegon Heights, Mich., is erecting a two-story, brick and steel foundry and machine shop, 50 x 150 feet.

A contract has been awarded for a 121 x 185-foot foundry addition to be erected for the American Brake Shoe & Foundry Co., 332 South Michigan avenue, Chicago.

The Downs-Slater Foundry Co., Wharton, N. J., has secured a site at Dover, N. J., on which it will erect several buildings. The main structure will be 40 x 100 feet.

The Salem Iron Foundry, Salem, Mass., has been incorporated with $10,000 capital by William S. McIntire, Annie W. McIntire and Peter F. Leonard.

The Clovis Factory & Foundry Co., Clovis, N. M., is being organized to engage in the manufacture of agricultural implements and also will operate a foundry.

E. C. Shaw and J. J. Welsh have purchased the foundry and machine shop owned by G. D. Colton & Co., Galesburg, Ill. Additional equipment will be installed.

The City Iron Foundry Co., Lowell, Mass., has been incorporated with $10,000 capital, by A. J. Harris, James J. Norton and M. E. Harris.

The Revere Foundry Co., Revere, Mass., has been incorporated with a capital stock of $5,000 by Edward H. Tibbetts; George A. Lloyd, Chelsea, and D. Carey.

The Stewart-Warner Speedometer Corporation will convert its Beloit, Wis., works into a malleable iron foundry and will transfer all finishing work to the Chicago plant.

A contract has been awarded for the erection of a foundry addition, 50 x 155 feet, to the plant of the Excelsior Steel Ball Co., Buffalo.

The Eureka Grave Marker Association, Stevens Point, Wis., will build a foundry and finishing shop of fireproof construction, 57 x 75 feet, two stories and basement, at a cost of approximately $15,000.

The National Foundry & Machine Co., Louisville, manufacturer of ice-making machinery, refrigerating equipment, steam and power pumps, will expend $200,000 in tripling the capacity of its plant.

The National Art Bronze Works, St. Louis, has been incorporated with $100,000 capital to operate a foundry. F. B. Schmidt, John C. Schmidt and F. C. Schmidt are the incorporators.

The Western Foundry & Mfg. Co., Springfield, O., has been incorporated with $10,000 capital by H. M. Siemendinger, C. O. Lutz, H. N. Pendleton, J. C. Howell and E. J. Shollenberger.

The Houghton Malleable Castings Co., Toledo, O., has been incorporated by Ira L. Houghton, Rupert Holland, F. A. Clark, Chas. S. Bolton and Richard H. Hitchcock. The capital stock is $100,000.

The Simonsville Mfg. Co., Waterbury, Conn., has been incorporated with $25,000 capital to engage in the operation of a foundry. Charles V. Roller, George A. Carney and Roderick J. Perrault are the incorporators.

E. E. Allyne, of the Allyne-Ryan Foundry

Co. and the Allyne Brass Co., Cleveland, has purchased a 6½-acre site on East 185th street, upon which a plant for making large aluminum castings will be built.

A two-story foundry and forge shop, 47 x 115 feet, to cost $25,000, is included in the plans for the new Pullman Free School of Manual Training, Chicago. C. F. Jobson, 79 East Adams street, Chicago, is the architect.

Barrett Bros., Inc., Boston, have been incorporated with $10,000 capital to conduct a foundry and machine shop. The incorporators are Edward A. Carroll, 675 Boylston street, H. M. Cook and W. N. Buffum.

The Manufacturers Brass Foundry Co., Detroit, has been incorporated with a capital of $3,000 to engage in the manufacture of small brass castings. L. C. Vecelius, G. J. Rinke and Richard Agricola are the incorporators.

Bids are being taken by Herbst & Hufschmidt, architects, Milwaukee, for the erection of an addition to the foundry of the Jaeschke Bros. Foundry Co., Milwaukee. The building will be of brick and steel construction, 50 x 100 feet.

The Dixie Foundry Co., Cleveland, Tenn., has been incorporated to engage in the manufacture of castings. The company is capitalized at $10,000 by J. C. McKenzie, S. B. Rymer, F. J. Earle, F. B. Mayfield and Charles S. Mayfield.

The Universal Tool & Die Co., Indianapolis, has been incorporated with a capital of $10,000 to engage in the manufacture of castings, machinery and dies. The directors are Charles J. McHugh, Edward W. Hohlt and Durward Rivers.

The Syracuse Forging & Machine Works, Syracuse, N. Y., has been organized to engage in the manufacture of forgings and castings. The company is capitalized at $550,000 by H. F. Butler, F. M. Hennesey and C. H. Geobel.

The Cunningham Foundry Corporation, Boonton, N. J., has been incorporated with $15,000 capital to operate an iron and brass foundry. The incorporators are Samuel W. Round, George W. Redfern, Jersey City, and James S. Cunningham, Boonton, N. J.

A stove foundry and manufacturing plant is to be established at Rockwood, Tenn., with $50,000 capital, by Sewell and Harry Howard, Fred G. Haggard and others. J. F. James, general manager of the Mascot Stove Co., Chattanooga, will be the manager.

The Empire Foundry Co., Port Chester, N. Y., has been incorporated with a capital of $5,000 to engage in the manufacture of cast iron pipe, gratings, iron covers, etc. W. A. Braun, J. Fuchs and B. Mills are the incorporators.

The Lebanon Machine Co., Lebanon, N. H., has been incorporated to operate a foundry and machine shop. The company is capitalized at $100,000 by Thomas P. Waterman, Thomas F. Dwyer, Arthur H. Hough, A. B. Hunt and Phil R. Hatton.

A contract has been awarded for the erection of improvements to the plant of the Johnson Bronze Co., New Castle, Pa. These will cost approximately $85,000 and include a new bronze foundry, 50 x 150 feet, of brick, concrete and steel construction, and a boiler house.

The Milton Foundry, Milton, Ont., Can., has been incorporated with $40,000 capital, to engage in the manufacture of machinery. The incorporators are Alexander Fasken, Excelsior Life building, Francis H. Hurley, 32 Aberdeen avenue, Duncan McArthur and others of Toronto.

John Reach & Co., Bridgeport, Pa., have been incorporated with $75,000 capital, to engage in the manufacture of gray iron castings. The incorporators are Joseph Reach, Brookline, Pa.; B. F. Evans and Joseph C. Lairs, Norristown, Pa., and Bertram C. Trimble, Philadelphia.

The Samson Sieve-Grip Tractor Co., Stockton, Cal., has been incorporated with $400,000 capital by F. A. Cramblitt, P. T. Cleghorn, V. Cassilis, W. H. Lyons and Fred Lambert. The company will take over the plant of the Samson Iron Works and will remodel it. A new brass foundry and a Rennerfelt electric steel furnace will be installed.

The Standard Steel Process Co. has been organized to take over a foundry at Easton, Pa. Improvements will be made in the plant, which will be devoted to the manufacture of steel and gray iron castings. The offices of the company will be located in Camden, N. J. O. L. Mills, Pittsburgh, is president and James Monahan, Phillipsburg, Pa., is treasurer.

NEW TRADE PUBLICATIONS

VALVES.—A 20-page booklet issued by the Wm. Powell Co., Cincinnati, is devoted to its extensive line of valves. Broken sections and sectional views of these valves are illustrated, showing their construction and a price list also is included.

AIR COMPRESSORS.—Steam and power-driven air compressors are illustrated and described in a 20-page bulletin issued by the Chicago Pneumatic Tool Co., Chicago. Details of construction are included and various methods of mounting these compressors are shown. The Chicago Pneumatic Tool Co., also manufactures air compressors of vertical and horizontal types.

STEAM CONDENSING PLANTS.—A 32-page bulletin issued by the Ingersoll-Rand Co., New York, is devoted to the Beyer barometric type of steam condensing plants. The subject of condensation is discussed at length, which is followed with details of the Beyer counter-current condensing plant built by the Ingersoll-Rand Co. Numerous installation views are included, showing these plants erected at different works throughout the country.

WELDING AND CUTTING HAND BOOK.—The Imperial Brass Mfg. Co., Chicago, has issued a hand book on welding and cutting, which contains 56 pages and which will prove of value to all operators of oxy-acetylene and oxy-hydrogen apparatus. Suggestions for beginners are included; the principles of welding are outlined; the apparatus is described and methods are detailed for doing specific jobs. This hand book should prove of value to all engaged in welding and cutting operations of any kind.

LOCOMOTIVE CRANES.—A 64-page catalog, issued by the Brown Hoisting Machinery Co., Cleveland, illustrates the extensive line of locomotive cranes built and the large number of service views presented clearly illustrates the wonderful adaptability of these machines. These cranes are shown in operation in the yards of all kinds of industrial plants, on large building operations, in railroad service, operating in connection with lifting magnets, and many cranes in foreign countries also are shown.

OVERHEAD TRACKING.—A comprehensive catalog, devoted to overhead tracking, has been issued by the Randall Tramrail Co., Philadelphia. This system is particularly adapted for installation in foundries for distributing metal, for handling molds, etc. Detail views of the overhead tracks are included, showing safety cross-overs, clamps, safety switches, hangers and plans of tramrail systems for iron foundries. A larger number of interesting installation views are given, showing various arrangements of this overhead system, the method of distributing cores piled on cages and the handling of pipe cores, being unusually interesting.

OXY-ACETYLENE WELDING AND CUTTING.—An instruction book on oxy-acetlyene welding and cutting, containing 48 pages, prepared by H. Sidney Smith and A. F. Brennan, has been issued by the Prest-O-Lite Co., Inc., Indianapolis. This work practically is a text-book on oxy-acetylene welding and cutting operations and it has been written in elementary style to enable those who have had little or no knowledge of this process to comprehend every detail of the various operations. The welding of cast iron, malleable cast iron and cast steel is described, and all of the necessary operations to be followed in welding are detailed. The welding of aluminum also is considered, as well as copper, brass, lead, etc. This instruction booklet, which now is in its fourth edition and sells at a price of 50 cents, should find a place in the library of every foundryman and user of iron and steel and aluminum products.

CRANES, HOISTS AND CUPOLAS.—The Northern Engineering Works, Detroit, manufacturers of foundry equipment, has issued three catalogs devoted respectively, to cranes, electric hoists and the Newten cupola. The crane catalog which consists of 64 pages, illustrates and briefly describes the extensive line of traveling cranes built by this company and numerous service views are included showing the installation and operation of these cranes in various industrial establishments. The electric hoist catalog which consists of 20 pages, shows portable hoists with both plain and enclosed controllers, trolley hoists, electric trolley and hoist, cab type hoists, monorail trolley hoists, trolleys, etc. The cupola catalog describes Newten furnaces in detail and shows numerous installations as well as equipment accessories for the foundry, such as ladles, core oven cars, tumbling barrels, foundry elevators, air hoists, etc.

SMOOTH-ON INSTRUCTION BOOK.—An instruction book detailing the uses of the products manufactured by the Smooth-On Mfg. Co., Jersey City, N. J., and containing 144 pages, recently has been issued. The iron compounds are intended for repairing leaks or breaks in castings and for making connections in steam or hydraulic work. One of these compounds is quick-hardening while the other is slow-hardening. Another iron cement is adapted for repairing blemishes, blow-holes or other defects in iron or steel castings and is made in two forms. In addition, various cements are manufactured for iron caulking, for making tight joints in structural iron or steel work, for weather-proofing, dust-proofing, oil-proofing, gasoline-proofing and hardening concrete. Another cement adapted for setting or coating firebrick is a combination of iron cement and heat-resisting fire clay. This instruction booklet should prove of value to all operators of industrial plants since these cements and compounds have wide industrial application.